

Effective Stakeholder Engagement in Variation Order Management at the  
Design Stage of Public Sector Construction Projects in Saudi Arabia

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## **ABSTRACT**

Variation orders affect the progress of any construction project and can be one of the main factors which may cause failure in delivering a project successfully. It is relatively difficult to deliver a project without any variation orders, which are most likely to occur at the design stage. Variation orders are complex in nature, as they involve the key stakeholders, together with a lot of information that needs to be requested, sent, checked, corrected, approved, clarified, transmitted or submitted, among many other processes. This research aims to develop a model that better manages variation orders in Saudi public construction projects in the design stage by engaging the stakeholders effectively in the process of the variation order management, to save the management time for the variation, improve the communication and relationships among stakeholders and avoid disputes and conflicts.

The methodology used to achieve the research aim, influenced by the pragmatic views of the researcher, combined several methods. A series of exploratory interviews investigated the current practice of variation order management in Saudi public construction projects, with its strengths and weaknesses. Then, a questionnaire survey measured the level of power and interest of the different stakeholders in order to develop a model for best practice. Finally, focus group sessions validated the performance and concept of the developed model.

The findings indicate that there are currently no formalised approaches to the management of variation orders at the design stage. In addition, there is a general lack of knowledge about managing variation orders. However, the conceptual model of common practice, based on these responses, can be divided into six main stages: identifying the variation order, analysing and evaluating variation orders, estimation, approval, implementation and documentation. Furthermore, the findings reveal a need to develop an appropriate variation order management system in the Saudi construction industry, due to the present lack of stakeholder engagement. A model for best practice of variation order management was then developed. The developed model determines the levels of power and interest, location and position for each stakeholder involved in the process of variation order management. The outcomes of the validation workshop were very positive from the participants. However, the participants put forward some recommendations, which were applied in the final version of the model.

## **DEDICATION**

This thesis is dedicated to

my father, my mother, my wife,

my son, my brothers and my sisters

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# ACADEMIC REGISTRY

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## **Chapter 1 – Introduction**

### **1.1 Background**

The Saudi construction industry is considered to be one of the largest construction industries in the Middle East and second largest industry in Saudi Arabia. The construction industry thus represents a major share of Saudi Arabia's domestic economy. The real sector growth for this industry between 2002 and 2007 was between 2.51% to 4.11% annually, on the back of increased public and private spending. However, the global economic slowdown brought about numerous project delays and cancellations, as well as declining commodity prices. As a result, construction sector growth slowed to 1.5% in 2008, while real gross domestic product (GDP) amounted to SR 58.8 billion (\$ 15.7 billion). New waves of government investment increased this annual growth rate to 4.7% in 2009 and in 2010 the growth rate increased rapidly to 6.4%, while the GDP reached SR 64.1 billion (NCB, 2011).

Moreover, by 2008 the construction industry in Saudi Arabia provided employment to more than 2.51 million employees, accounting for almost 40.4% of Saudi Arabia's total workforce; up 1.5% from 2007. This rise in the numbers involved in construction labour reflects the level of demand and work being implemented (NCB, 2011). The National Commercial Bank (2011) estimated that the investments made in 2009 would increase the construction firms' labour force by 4% to reach 2.62 million employees in the following five years. With this increase, it is expected that the firm's share of Saudi Arabia's total workforce will remain unchanged. According to the National Commercial Bank (2011), in 2010, 52% of firms hired new workers and just 5% reduced their headcount. In addition, this report estimated that the number of employees in the construction industry would go up by 5% over 2010 to reach nearly 2.75 million workers.

The Saudi construction industry is considered to be similar to other construction industries in the world, and thus suffers from the same problems. One of these problems that can cause severe risk to construction projects is a variation order.

Variation orders play a crucial function in the success or failure in delivering construction projects. Baxendale and Schofield (1986) define variation orders simply as any change that can occur to the basis which differs from the agreed and signed contract. Although every construction project is unique in many respects, liability to change is an attribute that characterizes almost all projects. This has led some researchers (e.g. Comp, 2002 and Revay, 2002) to claim that change is *a fact of life* for a construction project. In this respect, Hao. *et al.* (2008) assert “*Project changes and/or adjustments are inevitable as they are a fact-of-life at all stages of a project’s life cycle*”. Arain and Pheng (2007) explain that even in the case of the most thoughtfully well-planned projects, change might be necessary, regardless of the reasons.

In the context of the Saudi construction industry, a study carried out by Arain *et al.* (2006) found that the inconsistencies between design and construction had a negative impact on performance of construction projects in Saudi Arabia. They identified a number of factors that had led to this problem, including: the degree of involvement of the designer as a consultant; communication gaps occurring between the contractor and designer; insufficient details in the working drawings and a lack of coordination between the parties. As well the lack of qualified human resources in the design firms, the designer’s lack of knowledge of available materials and equipment and the use of incomplete shop drawings and specifications were cited as factors. Arain *et al.* (2004) claim that clients’ inexperience led to the adoption of inadequate designs, resulting in many changes to the drawings, specifications and contract terms, and consequently, failure in project performance. Furthermore, Arain *et al.* (2006) also suggest that, in order to achieve maximum project performance, there must be a significant presence and participation of the designer in both the design and construction phases. Al-Mansouri (1988) emphasises that time limitation in the design stage in the Saudi construction industry occasionally forced the designer to deliver the necessary design works at a lower quality. According to Arain *et al.* (2006), if insufficient time is given to the designer, the design cannot be developed in a proper manner. This issue may eventually cause misunderstandings among engineers working on the project.

Assaf and Al-Hejji (2006) studied causes of failure in construction projects in Saudi Arabia. They identified several factors relating to design that affect project performance. These factors include: “*mistakes and discrepancies in design documents; delays in producing design documents; unclear and inadequate details in drawings; the*



*complexity of project design; insufficient data collection and surveying before beginning the design; misunderstanding of the client's requirements by the design engineer; inadequate design-team experience; and the non-use of advanced engineering design software”.*

Based on the above claims made by earlier researchers, it appears that poor stakeholder engagement practices have led to failure in design performance, notably with variation order management. However, there is no single study that highlights the roles of the involved parties in any of the above approaches to manage variation orders, or even elsewhere. This lack of acknowledgement of the importance of stakeholder engagement during the process of variation order management has led to a high number of unnecessary interactions by stakeholders, unexpected claims, delay, and cost overruns that negatively influence the workflow of variation order management. It can thus be stated that the processes developed so far for variation order management fail to capture the significance of stakeholder engagement, that would assist in improving the workflow of the variation order management process.

Recent researchers in the construction industry (Newcombe, 2003; Olander, 2006) have realised the significance of stakeholder management in construction projects and have therefore paid more attention to it. In the construction industry, each project consists of various complex activities, which means each stakeholder has different levels of interest and power in the project they are involved in. Bourne (2005) states that a project's success or failure is strongly affected by both perceptions and expectations of its stakeholders. To Karlsen (2002), poor management of stakeholders can cause many negative impacts in construction projects, such as *“poor scope and work definition, inadequate resources assigned to the project (both in terms of quantity and quality), poor communication, changes in the scope of work and unforeseen regulatory changes”*.

It is clear from the above considerations that the improvement of stakeholder engagement would maximise the efficiency of variation order management. However, a review of the existing body of literature concerning the construction industry has revealed that little or no attention has been paid to the integration of stakeholder engagement into variation order management systems. The absence of a clear relationship between the engagement of stakeholders and their responsibilities in both

the existing variation order management practice and theory has prompted the researcher to further investigate how stakeholders are engaged in the current practice, and how they can effectively be engaged to better manage variation orders.

## **1.2 Research problem**

It is evident that variation orders are likely to slow down the progress of any construction project, which maybe one of the main factors leading to the failure in delivering a project successfully. Moreover, variation orders can cause delay in completion, cost overruns and, in some cases, lead to disputes and conflicts between the different parties in a project. The construction industry is therefore subject to poor performance, due to issues related to design and construction quality that may in turn cause the occurrence of variation orders, which leads to time delay and cost overruns (Egan, 1998; Alkhalil and Alghafly, 1999; Mohammed, 2007; Wong *et al.*, 2005).

It is very unlikely that a project would be delivered without any variation orders during the design stage or even the construction stage (Ssegawa et al., 2002), and it is not an uncommon situation (Construction Industry Institute, 1994b; Ibbs et al., 2001). Revay (2002) argues that there will certainly be variation orders in each construction project in its lifecycle, to design, time, cost and quality, in most of the phases, if not all. Ssegawa et al. (2002) also assert that the complex nature of construction projects entails that in order to complete a construction project, changes to plans or the construction process itself must be expected.

The design stage is considered to be a major source of problems for the subsequent stages in construction projects, even to the extent that it can be said to undermine systematic management during construction. These negative impacts are mainly transmitted through a high number of changes in the design that also negatively influence the preparation of the procurement and construction stages (Koskela et al., 2000). In fact, design changes are natural results of the design process. The complexity arises in multi-disciplinary design situations because changes made in one discipline commonly impact design descriptions in other disciplines (Zaneldin, 2000).

Clough and Sears (1994) claim that any major variations or additions in the design phase may increase the project total cost and Oladapo (2007) argues that variation

orders in the design stage always lead to poor performance, whether they are owner-initiated or consultant-initiated. As the design stage has a high likelihood of the occurrence of variation orders, it is the most appropriate area to focus on to trim down the number of these orders (Arain *et al.*, 2006).

Variation orders are complex in nature, as they involve the key stakeholders, together with a lot of information that either should be sent, checked, corrected, approved, requested, clarified, transmitted or submitted, among many other things (Charoenngam *et al.*, 2003). The complexity of variation orders needs to be managed effectively, otherwise disputes between stakeholders related to cost and time might occur (Arain *et al.*, 2004). Thus, effective stakeholder engagement is imperative to the success of any construction project. Despite this, no system identifies the positions or authorities of stakeholders in the variation order management process, to assist them to better manage variation orders and to overcome the potential obstacles. This issue of the lack of acknowledgement of stakeholder engagement in the established models, such as those of Charoenngam *et al.* (2003), Motawa (2004), Ibbs *et al.* (2001) and Arain (2008), can be considered as a deficiency for effective management of variation orders, particularly in the context of this research. As a result, employing these models can fail to produce the desired results, due to the absence of clear identification of stakeholder responsibilities and roles, which can negatively influence the progress of managing the variation orders and lead to conflicts and disputes.

Any organisation must engage with its stakeholders at all stages of the project to manage variation orders efficiently, as stakeholders must be involved in each single activity in the project (Chess and Purcell, 1999). Stakeholder engagement must result in valuable outcomes for those involved and must be communicated through an appropriate approach. Stakeholders must be involved in any variation order management system process. Moreover, the engagement of key stakeholders throughout project activities is considered to be one of the critical factors of success for construction projects. Hence, an effective method of engagement among the involved parties is needed to better manage variation orders. Chess and Purcell (1999) emphasise that engaging stakeholders at early stages is crucial for stakeholder analysis and decision-making. However, no approach yet addresses the task of explicitly engaging stakeholders in the management of variation orders.

Moving to the context of this study, the Saudi construction industry is considered as a comparatively young industry and the system of change management is not yet well established in this sector (Alsudairy, 1999). Assaf and Elhijji, (2005) stress that, due to this factor, variation orders are the most common cause of delay in the Saudi construction industry.. Similarly, a study conducted by Al-Dubaisi (2000) found that that variation orders were the major cause of failure in construction project performance in Saudi Arabia, because they led to cost and time overruns.

Arain *et al.* (2006) point out that the inconsistencies between design and construction have a negative impact on the performance of construction projects in Saudi Arabia. They also state that a number of factors are responsible. Some of these include: (a) the involvement of the designer as a consultant, (b) communication gaps occurring between the contractor and the designer, (c) insufficient details in the work drawings and (d) lack of coordination between the parties. The process of variation order management needs the stakeholders to be engaged in each step to help the project team to manage the variation order effectively.

In the context of the study, there are currently no formalised approaches to the management of variation orders at the design stage (see section 5.5). In addition, there is a general shortage of knowledge about managing variation orders. This issue could be attributed to the fact that there is a lack of understanding of stakeholder engagement during the variation order management process. This issue affects the design progress and leads to many problems in the design such as delay, cost overruns, design errors and conflicts among the stakeholders. Moreover, the consulting firms complain about unnecessary interactions by the public client when managing and implementing variation orders, due to the absence of stakeholder engagement practices. Therefore, there is concern about the poor stakeholder engagement in the current variation order management process. However, there is no clear link established between the variation order management process and stakeholder engagement in previous literature and projects.

The research therefore attempts to develop an appropriate model to raise awareness of the importance of effective stakeholder engagement during the process of variation order management in the Saudi construction industry.

The issues mentioned above have led to the main question of the research: how can the management of variation orders be improved in Saudi public construction projects and how can the stakeholders be better engaged in order to speed up the process, improve communication and relationships among stakeholders and avoid disputes and conflicts?

### **1.3 Saudi public construction projects and performance**

A study of the literature reveals that there are limited publications relating to Saudi construction project performance, specifically with regard to variation orders. In fact, has been the major client for the construction industry in Saudi Arabia, has been the Saudi government, accounting for approximately 67% of construction industry volume (Alsager, 2001). Government construction projects include a variety of projects such as residential houses, highways, government office buildings, schools, hospitals, airports, utility projects, cultural and recreational facilities, and power plants.

According to Falqi (2004) the Saudi construction industry suffers from poor performance and faces some difficult challenges. In this respect, several local studies have shown that there is widespread poor performance in Saudi construction projects. A survey conducted by Alsultan (1987) to examine the time performance in different types of construction projects in Saudi Arabia found that 70% of the construction projects experienced time overruns. Similarly, Alsultan (1989) found that there seemed to be no systematic engineering approach or at least no formal procedure followed by the public sector in Saudi Arabia in order to set contract duration for public construction projects. The absence of systematic engineering approaches led to delay and poor performance of the different construction management activities such as variation order management.

Bubshait and Al-Musaid (1992) carried out a survey to measure the level of involvement of public clients in the three main phases of the construction process in Saudi Arabia, namely the planning phase, design phase, and construction phase. The results of the survey indicated that the frequency of public client involvement in the construction phase was greater than in the planning and design phases. Additionally, the survey indicated that the frequency of public client involvement in the design phase was the least among the three phases. This low level of involvement is due to the nature of the public construction projects in Saudi Arabia, where public clients do not periodically review the progress of design professionals, but rather carry out the final approval. According to the study, public sectors usually had the facility and ability to

involve themselves more in the construction phase, notably in the project supervision, and in monitoring time, cost, and quality.

In general, the public clients in the Saudi construction industry were found to have less influence in the design phase than in the construction and planning phases, due to the nature of work in projects of public sectors. Hence, the study recommended that efficient public client involvement in the design phase would improve the total quality of constructed projects.

#### **1.4 Need for variation order management in Saudi construction projects**

The tasks of parties involved in construction projects in Saudi Arabia are not yet clearly identified in this relatively young industry (Almazyad, 2009) and the system of change management in the Saudi construction sector is not yet well established (Alsudairy, 1999). Problems in this area were found by Assaf and Elhijji, (2005) to be the most common cause of delay in the Saudi construction industry. This issue needs to be improved in order to overcome problems associated with construction industry, such as variation orders.

In an earlier study, Alkhalil and Alghafly (1999) carried out a preliminary survey to evaluate the time performance in Water and Sewage Authority construction projects and found out that 45 out of a total of 76 construction projects were delayed. This study also found that in the evaluated project changes were one of the major causes of delay. Similarly, Aldubaisi (2000) found cost overruns due to variation orders in Saudi construction projects to be between 6% and 10% from the original contract value and the delay because of variation orders was shown to be about 10% of the original project duration. Moreover, a study conducted recently by Alshehri (2012) revealed that design change orders are considered to be one of the key causes of conflict in architectural projects in Saudi Arabia.

From the above findings of local researchers, it can be strongly argued that variation orders need to be effectively managed in the context of the Saudi construction industry. This effective management will surely lead to savings in time and cost and avoid potential conflicts or disputes associated with variation order management.

However, there is a concern that any proposed method for effective management of variation orders may fail to improve the situation because of the lack of understanding the significance of variation order management. Therefore, it is suggested that designing a roadmap implementation strategy for the proposed system would assist the stakeholders to effectively move from the current practice to best practice. This would also help them understand the mechanism of the proposed method and avoid any potential obstacles due to the lack of sufficient information in the existing conditions.

### **1.5 Research aim and objectives**

The aim of this research is to develop a model that better manages variation orders in the design stage of Saudi public construction projects. This better management will be achieved by engaging stakeholders effectively in the process of the variation order management, to save the management time, improve the communication and relationship among stakeholders and avoid disputes and conflicts. This aim is supported by the following linked objectives.

- To investigate and evaluate the current practice of variation order management in Saudi public construction projects in the design stage and the existing models of variation order management.
- To determine the strengths and weaknesses in the existing condition of variation order management.
- To provide a suggestion for an appropriate technique for engaging the public client and design consultant in the process of variation order management in the Saudi context.
- To determine the responsibilities and positions of the stakeholders to speed up the process of variation order management, improve communication and relationships and avoid the potential problems.
- To design a roadmap implementation strategy to facilitate the application of the proposed model in the Saudi public construction industry.
- To evaluate and validate the developed model in terms of applicability, effectiveness and clarity.

## **1.6 Research scope**

As the construction industry includes several participants, systems and practices, it is impossible to include or cover all of these features in one single study. Therefore, the scope of this study is limited to the following aspects:

- This study deals with variation orders in the Saudi construction industry in the design phase. Other phases are not considered in this study.
- This study is limited to public building construction projects. Private sector projects are not included or considered in this study. There are no limitations on project type, project size and project cost.
- This study deals with parts of the public sector in Saudi Arabia that adopt the traditional procurement route. Other procurement routes are not considered in this study.
- This study focuses on governmental organisations as clients and consultancy firms as design consultants. Contractors are not included in this study, due to the fact that they are not involved in the design phase in the traditional procurement route.

The reasons behind selecting these limitations will be explained comprehensively in the following chapter.

## **1.7 Research methods**

In order to achieve the aim and objectives of this study, two different methods were employed, including both quantitative and qualitative data. The study consists of two key stages of data collection. Firstly, the data was obtained in the form of a series of exploratory interviews conducted with experts in the current practice of variation order management in the Saudi construction industry. The collected data was analysed manually but systematically. Then, based on three formulated propositions, the primary data was gathered from empirical work carried out in Saudi Arabia. This stage employed a quantitative questionnaire aimed to develop the model in this study; this was distributed to practitioners from both public sector and design firms. The collected data were analysed statistically using the SPSS computer programme. Finally, two focus groups were conducted with experts, to validate the applicability, effectiveness



and clarity of the developed model. The collected data were analysed both statistically and manually.

### **1.8 Research propositions**

The existing literature review concerning the construction industry has revealed that little or no attention has been paid to the integration of stakeholder engagement into the variation order management systems. Moreover, no attempt has been made in the construction research to identify the stakeholders' key characteristics during the variation order management process. For these reasons, three propositions have been formulated to confirm the purpose of integrating stakeholders and the basic principles of variation order management to improve the current practice. These propositions will enable the research and the subsequent data collection to be focused on the research area.

The propositions are:

- Determining an appropriate level of stakeholder engagement throughout each stage in the basic principles of variation order management leads to the greater success of the management of variation orders and can improve communication and relationships among stakeholders.
- Integration of stakeholder mapping into the current variation order management system will assist the design team to better manage variation orders by improving cooperation and determining responsibilities.
- Applying a system that identifies the level of power and interest for each stakeholder in the process of variation order management would enable them to contribute to the developed system to better manage variation orders, assist in saving time and overcome the potential conflicts and disputes during the process of variation order management.

### **1.9 Contribution**

The main contribution of the research is the development of a variation order management model to better manage variation orders in the Saudi construction industry. The developed model emphasises the integration of the basic principles of variation order management and the stakeholder-mapping approach to engage the involved

parties in managing variation orders effectively. The research also provides an extensive review of the Saudi construction industry, in terms of design stage practices, causes, impact and management of variation orders and stakeholder engagement practices. It thus identifies the gap in existing knowledge with regard to the linkage between the variation order management systems and stakeholder engagement practices in the Saudi construction industry, notably in public construction projects.

Currently, in the existing situation, there is no formalised approach in the context of the study to manage variation orders. Hence, the best practice is sought to avoid the shortcomings and find solutions to better manage variation orders. Additionally, the position and role of the stakeholders, notably the public client and the design consultant is identified and how their positions will change from step to step.

#### **1.10 Thesis structure**

This thesis will be divided into nine chapters. A brief introduction to each chapter is given in this section in order to outline the logical progression of this thesis. Figure (1.1) presents the structure of the thesis.

#### **Chapter 1: Introduction**

This chapter has introduced the background and problem of the research and outlined the aim of this thesis, which can be basically described as to better manage variation order in the design phase in the Saudi public construction projects. The research consists of several objectives to be achieved through a comprehensive literature review and also fieldwork study in Saudi Arabia. As the construction industry includes several participants, systems and practises, so it is impossible to include or cover all of these features in one single study. Therefore, this chapter has determined the scope and limitations of the study and identified the contribution and structure of the thesis.

#### **Chapter 2: Impact and management of variation orders**

This chapter provides an in-depth review of the existing body of literature on the impact, types, causes and management of variation orders in the construction industry. It also provides a clear understanding of the Saudi construction industry in terms of design stage practice, performance of public construction projects, procurement routes and client and consultant attitudes in initiating variation orders. This chapter provides a

clear picture of the Saudi public construction projects, to assist the researcher in better understanding and improve the subsequent research. The chapter reviews the developed models of variation order management to highlight the roles of the parties involved. Two different taxonomies of variation orders from the existing literature are then drawn up, to support the theory of the proposed research and enable the researcher in producing a solid base for managing variation orders in construction projects.

### **Chapter 3: Stakeholder Management in the Construction Industry**

In this chapter the researcher aims to provide a clear perspective of the relationship between the process of variation order management and stakeholder management, as represented in both the existing body of literature and the current practice in Saudi Arabia. Therefore, this chapter reviews and classifies the existing body of literature on stakeholder management in the construction industry. Additionally, the relationship between the stakeholder engagement and variation order management is addressed, in order to investigate whether there is a clear link between them or not. This chapter also investigates the level of stakeholder management and engagement in the current practice of variation order management in the Saudi public construction projects and what are the current deficiencies and how can be integrated effectively. This chapter acknowledges the lack of stakeholder engagement in the existing models of variation order management, leading the researcher to investigate the current practice of variation order in the Saudi construction industry and the responsibilities of the different stakeholders to manage variation orders effectively.

### **Chapter 4: Research Methodology**

The theoretical positioning of the research relating to better management of variation orders is presented in this chapter. It synthesises the findings of the previous chapters to assist in the subsequent development of the research. Additionally, this chapter establishes research philosophies, approaches and paradigms, and determines the research methodologies and suitable methods to collect and analyse the required data. In this chapter, the researcher examines the modelling techniques used in construction research and identifies the need for a model to fulfil the study aim and objectives.

### **Chapter 5: Current practice of variation order management (Qualitative stage)**

This chapter explains the work carried out during the qualitative stage of the research. The aim of this chapter is to better understand the current practices of variation order

management in the Saudi public construction industry. This chapter describes how the data collection was achieved by carrying out a series of exploratory interviews with carefully selected people from the public sector and consulting firms. The collected data from the semi-structured interviews were analysed manually but systematically, as described by Ritchie et al. (2003). The major findings of this study indicate that there is currently no formalised approach employed to manage variation orders at the design phase in these Saudi public construction projects. However, the basic principles for any variation order management system are applied in most organisations. The model of common practice drawn up in this research is based on the process revealed by the responses which can be divided into six main stages: identifying, analysing and evaluating variation orders, estimation, approval, implementation and documentation. In order to facilitate the research findings, a thematic matrix was constructed with extreme care with regards to the amount and content of the collected data.

#### **Chapter 6: Best practice of variation order management (Quantitative stage)**

Based on the qualitative findings and the literature review of variation order management and stakeholder management in the construction industry, many questions have arisen. In an attempt to provide answers to the questions, it was crucial to formulate research propositions to confirm the purpose of integrating stakeholders to better manage variation orders. Moreover, a quantitative study was conducted to identify the levels of power-interest for different stakeholders in the current variation order management system in Saudi construction industry. The questionnaire aimed to understand the levels of power and interest of the different stakeholders in order to develop a model that integrates the stakeholder power-interest matrix and the current process of variation order management. This chapter presents a descriptive and statistical analysis of the results that emerged from the quantitative survey and furthermore, verifies the research propositions to confirm the need for a system to better manage variation orders in the Saudi public construction projects.

#### **Chapter 7: Results and model development**

This chapter presents the results of the analysis, showing the level of power and interest for the involved stakeholders in each step of the variation order management process and their locations and positions in the developed model. The technique of integrating this matrix with the entire process of variation order management is then illustrated. The implications of the integrated system to provide best practice are clarified in this

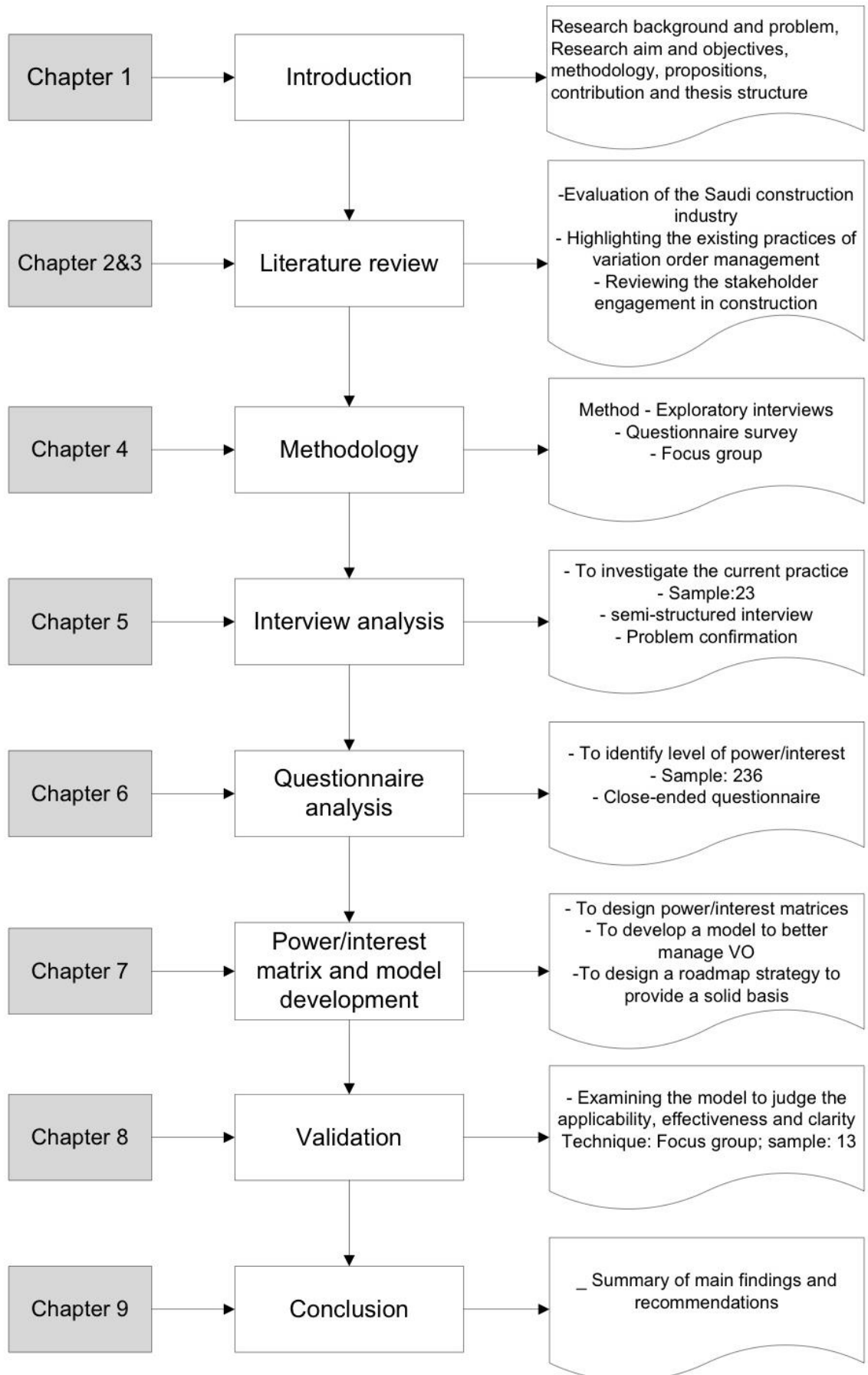
chapter. The integrated system makes several contributions to better manage variation orders. At the end of the chapter, a best practice implementation strategy is provided to assist the public clients and design consultants to implement the developed integrated system effectively.

### **Chapter 8: Model validation and improvement**

In this chapter, the third stage of the study, the validation process of the developed model is presented. The results from the two focus group sessions are used to carry out the external validity testing. This method is used to elicit the opinions of experts in the field of variation order management to test the effectiveness, clarity, applicability and identify possible improvements in the variation order management model. The developed model was improved with two minor amendments, based on the results of this chapter. Additionally, an example of a typical variation order was managed through the final version of the best practice model to illustrate how it works out.

### **Chapter 9: Conclusions and recommendations**

This chapter provides an overview of the thesis and draws conclusions based on the previous chapters. Limitations and the overall contribution to knowledge are highlighted. This chapter also presents the key findings of the study and suggestions and recommendations for future research.



**Figure 1-1 The thesis structure**

## **Chapter 2 - Impact and management of variation orders**

### **2.1 Introduction**

This chapter provides in-depth review of the existing body of literature concerning variation orders in the construction industry. The chapter starts with an overview of variation orders in the construction industry followed by the definitions of variation orders. It then explains the, types, causes, influences and the occurrence and impact of variation orders in the design stage. It also provides a clear understanding of the Saudi construction industry, based on the literature, in terms of design stage practice, performance of public construction projects, procurement routes, regulations and the client and consultant attitudes in initiating variation orders. Models developed internationally to manage variation orders are also reviewed and two different taxonomies of variation orders from the existing literature are presented.

### **2.2 Overview of variation orders**

Although every construction project is unique in many respects, liability to change is an attribute that characterizes almost all projects. This has led some researchers (e.g. Comp, 2002 and Revay, 2002) to claim that change is *a fact of life* for a construction project and Hao, Shen, Neelamkavil and Thomas (2008) assert “*Project changes and/or adjustments are inevitable as they are a fact-of-life at all stages of a project’s life cycle*”. Even in the case of the most thoughtfully well-planned projects, change might be necessary regardless of the reasons (Arain and Pheng, 2007). As Ssegawa et al., (2002) explain, sources that might trigger change in a construction project can be as simple as a change of mind on the part of the clients, their consultant or unforeseen problems raised by the main contractor or sub-contractors. The change occurring might, therefore, relate to particular aspects like finance, design, aesthetic, or geotechnical issues, among others.

Complex nature of construction projects entails that in order to finish a construction project, changes to plans or in the construction process itself must be expected. As for the construction plans, they often take the forms of designs, drawings, quantities and specifications earmarked for a specific construction site. Although the nature and frequency of change might differ (Construction Industry Institute, 1994b; Ibbs et al.

2001), effective management of such change is a crucial factor (Hanna et al. 2002, Hao et al. 2008), as there are many factors that might result in impediments that could cause holdups to the project completion or at least delay completion time (Arain et al. 2004). These may include the performance of construction parties, resource availability, environmental conditions, involvement of other parties and contractual relations (Arain et al. 2004) as well as modification/alteration to the contract duration, total in/direct costs, or both (Ibbs, 1997) In fact, this type of management is essential and requires, according to Hester et al. (1991), the capability to foresee potential impacts and to have power over the linked cost and schedule consequences. That is why Ibbs et al. (2001) advise that lessons learned from past similar projects should be acknowledged by including them in project controls.

### **2.3 Definitions of variation orders**

Generally speaking, a variation order is identified as an “*approved change in a specification or project*” (Longman Business Dictionary, 2009). However, a review of the literature indicates that various definitions of a variation in not uncommon. In fact, no single definition of what constitutes a variation exists. Turner (1990) states that they form “*changes within a contract and not changes of the contract*”. Gbeleyi’s (2002) definition refers “*to change in specifications, changes in scope, adjustment of PC and provisional sums, errors/omissions in contract documents, discrepancies in contract documents, changes in government policies/legislation, and natural occurrence*”. According to Baxendale and Schofield (1996), however, a variation formulates whatever changes that might occur to the original contract after it has been signed, in the sense that any alteration to the terms of a contract or to the stages that follow signing the contract would count as a variation. That is why Ssegawa *et al.* (2002) explain that a variation can be seen as an alteration not only to the work, but also to the procedures through which such work is to be completed. Procedures might include the costs which follow the creation of a legal relationship between client and contractor, as explained by Choy and Sidwell (1991) and Wallace (1994).

Hence, a straightforward definition of a variation order is that it is the official document that is used to amend the initial contractual agreement and becomes part of project’s documents (Fisk, 1997; O’Brien, 1998). However, this order is further distinguished as a written order to the contractor signed by the owner and delivered after implementation of the contract, giving permission for a change in the work or an alteration in the



contract sum or the contract time (Clough and Sears, 1994) and hence the existence of a *contingency sum* (Arain and Pheng, 2005) which is intended to serve this purpose.

## 2.4 Causes of variation orders

A review of the literature indicates that the actions of different stakeholders (e.g. client, architect, contractor) might be direct causes of variations, and that variations can be initiated for different reasons, be they design, financial, aesthetic, changes in drawings, weather or geological and geotechnical reasons (Ssegawa *et al.*, 2002, Hibberd, 1986; Turner, 1990). Arain (2005) categorises the causes of variations into five categories. These are:

- *owner-related variations (ORV),*
- *consultant-related variations (CRV),*
- *contractor-related variations (CTRV),*
- *other variations (OV), and*
- *combinations of causes (CC).*

Following a similar line of thought, Gbeleyi (2002 cited in Oladapo, 2007) provides a list of common causes of the occurrence of variation orders within the construction industry. These are as follows:

- *Contractor. (Because of the defects in the construction).*
- *Consultant. (Architect-Designer) because of the defects in the design.*
- *Unforeseen circumstances.*
- *Site conditions.*
- *Funding of the project.*
- *Delay in supplying the materials.*
- *Protocols and laws.*

- *The method of the procurement route.*
- *Errors in the drawings, documentations and specifications.*

Further to these, variation orders might be triggered by a number of other reasons. Ramus and Birchall (1998), for example, assert that variations could occur in any of the following situations:

- When the architect needs or wishes to vary the design or the specification;
- When a discrepancy is discovered between any two or more of the contract documents
- When a discrepancy is discovered between any statutory requirement and any of the contract documents; and
- In case of an error in or omission of one part of more of a contract.

Atkinson (1999) asserts that variation orders can also occur when one party would gain profit as a result of the variation order. Likewise, Al-Seadan (2004) explains that variation orders are hard to negotiate with the contractor because the contractor wants to decrease his/her loss and increase their profit by escalating the cost of the variation orders.

## **2.5 Factors influencing the occurrence of variation orders**

Variation orders are likely to happen in all different construction projects. Nevertheless, the frequency of their occurrence differs from one to another, depending on variety of factors (Arain and Pheng, 2005b). Factors influencing the occurrence of variation orders comprise different aspects such as the nature of the project, the complexity and the procurement method used for the project.

### **2.5.1 Nature of variation orders in the construction industry**

As Segawa *et al.* (2002) explain, the complex nature of construction projects suggests that in order to finish a construction project, changes to plans or the construction process itself must be expected. As for the construction plans, they often take the form of designs, drawings, quantities and specifications earmarked for a specific construction

site. Although such changes are not uncommon in all sorts of construction projects, the nature and frequency of change might differ (Construction Industry Institute, 1994b; Ibbs *et al.* 2001). Charoenngam *et al.* (2003) characterise variation orders thus: 1) a written document containing authorization of the requested change, 2) the change is brought about through no fault of the contractor, and 3) the changed work is not included in the original contract and therefore it is not included in the contract price. Love (2002) found that refurbishment and renovation projects are considered prone to higher variation orders than new build projects because of the degree of uncertainty and complexity associated with the building work.

### ***2.5.2 Complexity of the project***

Project complexity is a result of continuous demands for speed in construction, cost and quality control, health and safety in the work place and avoidance of conflicts and disputes, together with technological advances, fragmentation of the construction industry and environmental issues (Gidado, 1996).

The level of project complexity is categorised as low, medium and high (Ireland, 2007) and the greater the project complexity, the greater the likelihood of variation order occurrence. If a variation order is initiated, due to the complexity of the design, it may take long time for the design members to understand the required design changes and draw up redesigns to implement the variation order.

### ***2.5.3 Project size***

Variation orders are very common to most projects, and particularly common in large construction projects (Hao *et al.*, 2008). The size of a project is a significant factor of variation order occurrence to be taken into account in connection with the type of the construction project. Project size is widely accepted as an essential factor to determine the proper management strategies. Sidwell (1983) identified project size as a major variable influencing the occurrence of variation orders. Project sizes are denoted either by their physical attributes or their value. Large projects are generally complex and this complexity will be a cause for variation orders (Akinsola, 1997).

## **2.6 Variation orders: possible impact**

The possible impacts of variation orders are well documented in the literature (CII, 1986; CII, 1990; Clough and Sears, 1994; CII, 1994; Thomas and Napolitan, 1995; Fisk, 1997; Ibbs et al., 1998 Arain and Pheng, 2005). However, the overall impact is often categorized in terms of 16 commonly acknowledged aspects. These are now discussed.

### **2.6.1 *Impact on progress***

One of the most cited impacts of variation orders is that affecting the overall progress of the project (e.g. CII, 1994; Assaf et al., 1995). Put another way, variation orders often result in delay and time is always the equivalent of money in business. However, the effect of the variation order may vary depending on the time delay it might cause and subsequently the amount of money needed to complete the project.

### **2.6.2 *Cost***

Another commonly addressed element that might formulate potential impact on a variation order on a project is that of cost. The change in one of the project elements, for example design, might result in a change in cost and for this reason a contingency sum is often maintained to attend to any possible variations in the project, as pointed out by Clough and Sears (1994) and Assaf et al. (1995).

### **2.6.3 *Employment of new professionals***

Although the frequency of variation orders differs from project to project, they are often described as “frequent” in complex technological projects (CII, 1995), where there is a need for professionals whose expertise is considered a fundamental requirement for such complex projects (Fisk, 1997). Hence, hiring new experts or replacing existing teams might arise as essential needs for a project entailing varied impacts on the progression of the project.

### **2.6.4 *Increase in overhead expenses***

Implementation of any given variation order requires *processing procedures*, paper work and reviews before they can even be implemented (O’Brien, 1998), which would generally result in increased overhead expenses for the stakeholders, and this where the contingency fund mentioned earlier comes to the fore.

#### **2.6.5 Delay in payment**

Another related element of the impact is delay in payment which, if it occurs frequently enough (CII, 1990), may often result in impeding the progress of the project, achievement of the targeted landmarks during construction (CII, 1995) and timely payment to contractors. Accordingly, there is also a possibility of serious problems where subcontractors will not be paid due to the delay in the contractors' payment.

#### **2.6.6 Quality degradation**

High frequency of variation orders might entail an impact on the quality of work (Fisk, 1997). According to CII (1995), the quality of work is generally poor due to frequent variation orders as contractors tended to compensate for the losses by cutting corners.

#### **2.6.7 Productivity degradation**

Variation orders also have a direct relationship with individual and group productivity, especially in cases of lack of materials and information, as well as the work becoming out of sequence. The frequent interruptions, delays and redirection of work are often associated with psychological aspects that could easily de-motivate personnel at all levels. Accordingly, productivity is questioned, as Ibbs (1997) describes how this negative association between variation orders and productivity can be translated into labour costs or monetary value. In this respect, Thomas and Napolitan (1995) concluded that variations normally led to disruptions and these disruptions were responsible for labour productivity degradation. Hester *et al.* (1991) suggest that productivity is often influenced because individuals have to put up with extra working hours, work overload, and prolonged periods to compensate for schedule delays. Management of variation therefore requires management of disruptions, although some disruptive effects might be inevitable.

#### **2.6.8 Procurement delay**

Hester *et al.* (1991) observed that procurement delays were common effects of variations related to new resources for construction projects and variation orders that occur when construction is ongoing may require revised procurement requests O'Brien (1998). Procurement delays can be also frequent due to variations that require new materials and specialised equipment.

### **2.6.9 Rework and demolition**

While variations forced while construction is in progress or even completed can lead to delays in project completion (CII, 1990), it is not uncommon to encounter rework and demolition as a result of variations in construction projects (Clough and Sears, 1994). The knocking down and rework of certain areas might be predictable due to variations during the construction phase, but they can also happen even after project completion.

### **2.6.10 Logistics delays**

Fisk explains that (1997) when variations are made on the basis of requirements of new materials, tools and equipment, delays can be caused by logistics. Similarly, Hester *et al.* (1991) found that logistics delays were significant effects of variations in construction projects.

### **2.6.11 Damage to firm's reputation**

As variations can be identified as a major starting point for claims and disputes (Fisk, 1997; Kumaraswamy, 1998), it can be predicted that such claims and disputes will affect the firm's reputation, which might, in turn, result in insolvency, in severe cases. In fact, variations can result in endless and serious disputes between the different groups of stakeholders.

### **2.6.12 Poor safety conditions**

Safety conditions within any given project can be affected because of variations (O'Brien, 1998; Arain *et al.*, 2004), for example, variations in construction method(s), materials and equipment might necessitate additional safety measures during the construction process.

### **2.6.13 Poor professional relations**

As mentioned earlier, disputes are often triggered because of variations (Fisk, 1997) which can create a tense atmosphere among different groups of stakeholders. This is why procedures presented in the contract and fair allotment of risks can be helpful in terms of putting an end to disputes, through finding the middle ground rather than initiating a court case (CII, 1986; Arain *et al.*, 2004).

#### ***2.6.14 Additional payments for contractor***

Unsurprisingly, any additional payments for a contractor(s) involved in a project could enhance the potential impact of variations in construction projects. This is why the contractor often anticipates variations in the construction project, as they often entail extra payments. Variations are therefore seen to be a customary source of extra work for the contractor (O'Brien, 1998).

#### ***2.6.15 Disputes among professionals***

Similarly to poor professional relations, potential disputes among the different groups of stakeholders are possible effects of frequent variations in construction projects. Although such disputes over variation orders and claims are often expected and might even become inevitable (CII, 1986), procedures presented in the contract and fair allotment of risks can be advantageous in putting an end to disputes through finding the middle ground rather than initiating a court case (CII, 1986; Arain *et al.*, 2004).

#### ***2.6.16 Completion schedule delay***

Completion schedule delays can also be considered a direct result of variations in construction projects (Ibbs, 1997). Zeitoun and Oberlender (1993) reported that 9 percent of the delays to the original schedule for 71 fixed price projects studied were due to variation orders. Likewise, Kumaraswamy (1998) examined claims for extensions of time due to excusable delays in Hong Kong's civil engineering projects and, based on their findings, claimed that 50% of the delayed projects resulted from variations.

### **2.7 Types of variation orders**

A number of researchers have provided typologies of variation orders. For example, Cox (1999) put forward a trichotomy that describes types of change:

- a formal change order, which is an actual document called “change order” issued by a client, which modifies the contract terms, plans or specifications;
- a productive change order, which is extra contract work performed pursuant either to oral or implied owner directives, or as a result of problems for which the owner is responsible; and

- a principal change order, which may occur whenever there is a considerable amount of work required outside the scope of the original contract.

Similarly, Ndiokubwayo (2008) cites Arain & Pheng, (2005b) who categorise these orders as *beneficial* or *detrimental*. According to Arain & Pheng, (2005b), a beneficial variation order is one delivered to better the quality standard, trim down cost, timetable, or degree of difficulty in a project. Ndiokubwayo (2008) explains further that a beneficial variation is generally instigated for value analysis purposes, to accomplish a balance between the “cost, functionality and durability aspects of a project to the satisfaction of clients”. He also cites other researchers who suggest that value analysis, as an approach, represents a value study of a project, already built or designed, to analyse the product with the purpose of possible improvement (Zimmerman and Hart, 1982): thus, value analysis is “the identification and elimination of unnecessary costs which are defined as costs which provide neither use, nor life, nor quality, nor appearance, nor customer features” (Kelly and Male, 2002). This means, the beneficial element of a variation order is initiated when the client's value is secured. According to Kelly and Duerk (2002), the elements of the client's value system include time, capital cost, operating cost, environment, exchange or resale, aesthetic/esteem and fitness for the purpose.

On the other hand, detrimental variation orders represent the negative side, as explained by Ndiokubwayo (2008), citing Arain & Pheng's (2005b) description of a detrimental variation order as “one that negatively impacts the client's value or project performance”. Put another way, a client who is experiencing financial problems may require the substitution of expensive, quality, standard materials with cheap, substandard materials.

## **2.8 Impact of procurement methods**

In order to understand the mechanism of initiating variation orders and approaches to their management, it is imperative to explain the procurement methods and their impacts on variation orders, notably in Saudi Arabia. The contributors in a construction project comprise a multi-organisational body, generally including a client, architects, engineers, project managers and contractors. The way followed in constructing the project varies from one project to another. Typically, a procurement route provides a



form of contractual arrangement between parties to the contract. One type of procurement method may cause more variation orders than another. For example, Love (2002) believes that non-traditional procurement methods are subject to greater occurrence of errors and variation orders than the traditional methods, although the cost of variation orders does not significantly differ among procurement methods used.

Generally, any parties involved in the project can issue a variation order, which has to be in written form; although, in some cases, an oral form is acceptable as well (Charoenngam *et al.*, 2003). The process of obtaining a variation order takes a considerable amount of time, before getting the approval from all the parties in the project. Once a change order is submitted and approved, it generally serves to alter the original contract, such that the variation order now becomes part of the contract. A good construction contract includes provisions for dealing with variation orders to the project and a mechanism to settle disputes.

### **2.8.1 Traditional method**

Traditionally, a client who plans a project to be constructed would invariably commission a design consultant to prepare drawings of the proposed project and, if the project is sufficiently large, employ a quantity surveyor to prepare the required documentation to enable a contractor to prepare a bid price (Ashworth, 1998). Since the works start on site only when the design is finished, the variation order occurrence in this case is minimized and easily managed. Koushki *et al.* (2005) found that clients who spent more time and money on the design phase initiated less variation orders than those who spent insufficient money and time in this phase. The more time spent on completing the contract documents before beginning of works, the more likely the avoidance of discrepancies between the contract documents, and errors and omissions in the design.

However, variations in the traditional procurement route are more common than in other procurement routes (Segawa *et al.* 2002). Turner (1990) indicates that since clients and their consultants control the origin of variation orders, variations should not happen if the pre-construction design has been good enough.

The main characteristic of the traditional procurement route is the separation between the two stages, namely, design stage and construction stage, which makes the overall project duration quite long, compared with other types of procurement routes, which might increase the total cost of the project (Hughes et al., 2007). As a result of this separation, the client appoints a team of consultants in order to prepare the contract documents that include a design, drawings, specifications and tender documentation. Once the contract documents are complete, the client invites contractors to tender through a competitive process. After that stage, the client engages in contracts, in most cases with the contractor who provides the lowest price.

Naturally, as in any procurement route, the traditional route has some advantages and disadvantages. In the context of this research, the relevant advantages and disadvantages are as follows:

#### **Advantages**

- The cost certainty is reasonable and known before the project has been constructed. For this reason, this procurement route is widely used in the public sector in Saudi Arabia (Al-Seadan, 2004)
- Quality and design risk are low due to the fact that the majority of the work is completely designed.
- A competitive process of tendering leads to a low price for the client (Al-Sinan, 1986).
- The procedures of the traditional procurement route are well known.
- Variation orders are easily arranged and accurately valued (Masterman, 1992).

#### **Disadvantages**

- Variation orders are more common in the traditional procurement route than other procurement routes (Ssegawa *et al.*, 2002).
- The design must be totally complete before appointing the contractor.
- The contractor is not involved in the design phase, which might result in a less efficient building process.

- The slow start on the construction work on site and the duration of the project is quite long.
- Variation orders are difficult to negotiate with the contractor because the contractor wants to minimize his/her loss and maximize his/her profit by inflating the cost of the variation orders (Al-Seadan, 2004).

### **2.8.2 *Non-traditional methods***

Over the years other, non-traditional, forms of procurement have emerged. Ashworth (1998) suggests that variation orders in procurement methods are the cause of a move away from the craft base to the introduction of off-site manufacture, the use of industrialised components, the wider application of mechanical plant and equipment, the improved knowledge of production techniques, the recognition that involvement of the contractor in both the design and the way works are carried out on site will result in better quality of finished works. For instance, the design and build procurement method where the contractor is responsible for both the design and build are deemed to overcome the problem of variation order occurrence. The participation of contractors in the design allows an opportunity for them to employ specialised knowledge and methods of construction evolving from their own design and, as a result, there is less scope for variation orders (Ashworth, 1998). Nonetheless, design and build provides little flexibility for making variation orders, which can cause both cost overruns and delay in completion. Once the parameters are set, there is little opportunity to issue variation orders. The method requires client discipline and a clear statement of the clients' requirements at the outset. The characteristics of the design and build procurement route tends to trim down variation orders from the original design, and thus disruption of the works is less likely to arise.

## **2.9 Procurement regulations for Saudi public sector**

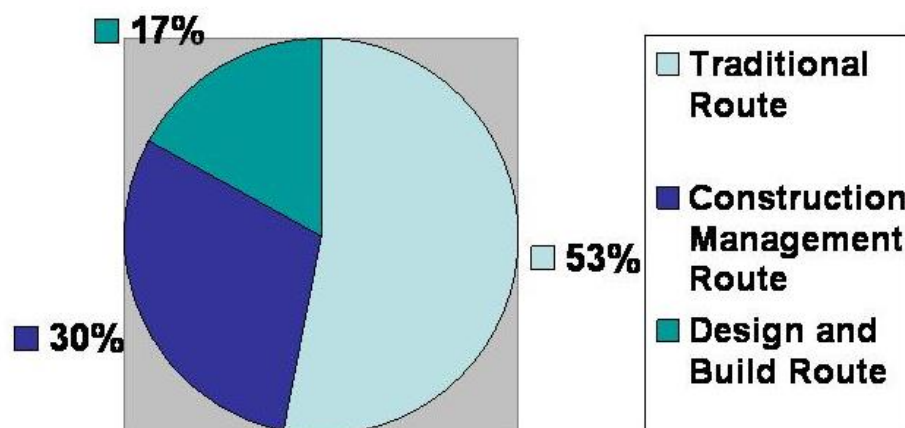
The Ministry of Finance introduced the Government Tenders and Procurement (GTP) law in the Kingdom of Saudi Arabia in 2006. All public sector bodies (e.g. ministries, public agencies, and public institutions) are considered by this law to be client representatives. Public sector bodies are empowered with full contracting authority to procure works and services, including construction projects. However, all works or services that need to be procured must be put out to public tender, except those exempted under the provisions of this law. For example, this law exempts the design consultants from public tender, as they can be appointed by invitation or through

recommendation of the client's representative. When the process of selection is completed and a contractor is appointed, it is essential to put the Standard Public Works Contract (SPWC) in place. This contract is designed based on the traditional procurement route.

### ***2.9.1 The traditional procurement route in Saudi public construction projects***

Most governmental construction projects in Saudi Arabia implement the traditional procurement route (Aljarallah, 1983; Alturki, 2000; Al-Saedan, 2004). The traditional procurement route is commonly used and known to most clients in Saudi Arabia in both the public and private sectors. The traditional procurement route is widely used in the public sector in Saudi Arabia because the cost certainty is reasonable and known before the project has been constructed (Al-Saedan, 2004). The cost certainty is mentioned in Article 5 of the Standard Public Works Contract (SPWC) for Saudi public construction projects. However, this article is subject to increase or decrease, corresponding to changes in the quantity of the actual works performed by the consultant or contractor, upon request of the work owner within the limits stipulated in the contract conditions.

Other types of procurement routes are also used in Saudi Arabia, such as the construction management procurement route and design and build procurement route. However, these procurement routes are applied in limited construction projects or in private sector projects. Figure 2.1 shows the total percentage of each procurement route used in construction projects in Saudi Arabia.



**Figure 2-1 Frequency of procurement routes used in the public sector in Saudi Arabia**

**Source: (Al-Saedan, 2004)**

The procurement route and the Standard Public Works Contract (SPWC) are beyond the scope of this research as they deal with the construction phase. This approves the need for a formalised system for the design activities. Thus, this research deals with one of these activities, namely variation order management in the design stage.

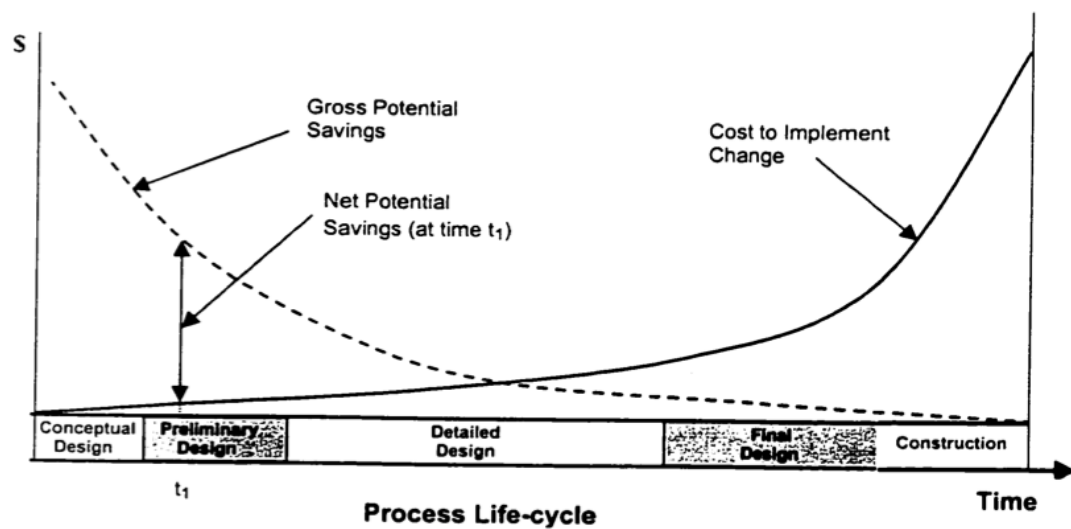
## **2.10 Variation orders in the design phase**

The design stage is considered to be a major source of problems for the subsequent stages in construction projects, even to the extent that it can be said to have undermined systematic management during construction. According to Koskela et al., (2000) these negative impacts were mainly transmitted through the high number of changes in the design that also negatively influenced the preparation of procurement and construction.

The design phase is totally unlike the construction phase, and so they are two separate functions. As a result of this separation, it is very unlikely for a project to be delivered without any variation orders during the design stage or even the construction stage (Ssegawa *et al.*, 2002), and it is not an uncommon situation (Construction Industry Institute, 1994b; Ibbs *et al.*, 2001). In fact, it has been argued by Revay (2002) that there will certainly be variation orders in each single construction project in its lifecycle, to design, time, cost and quality, in most of these phases, if not all. Ssegawa *et al.* (2002) further explain, the complex nature of construction projects suggests that in order to finish a construction project, changes to plans or the construction process itself must be expected.

Here Arain and Pheng (2007) explain that even in the case of the most thoughtfully planned projects, change might be necessary regardless of the reasons. Furthermore, the timing of change is another factor that researchers often highlight. An assertion often made is that change is most likely to occur at the planning stage although such assertions, explains Arain (2008), do not preclude late changes which might happen during the construction stage(s), and frequently result in serious interference with the project. The construction industry therefore is subject to poor performance due to problems related to design and construction quality that may cause the occurrence of variation orders, which leads to time delay and cost overruns (Egan, 1998; Alkhalil and Alghafly, 1999; Mohammed, 2007; Wong *et al.*, 2005).

Design changes are natural results of the design process. The complexity arises in multi-disciplinary design situations because changes made in one discipline commonly impact design descriptions in other disciplines (Zaneldin, 2000). In fact, variation orders are easy to manage in the design phase, as these variations do not require any rework or demolition (Arian and Pheng, 2007). Additionally, during the early stages of the design process, variations can be conducted at minimum cost and have the greatest potential for maximum saving. (Zaneldin, 2000). In other words, according to Bearup (1995), the earlier variation orders are conducted, the greater time value will be realised, as illustrated in Figure 2.2.



**Figure 2-2 The time value for changes**

**Source: Bearup (1995)**

In addition, the design stage is the one with the highest likelihood of variation orders occurring. It is therefore the most appropriate area to focus on to trim down the amount of variation orders (Arian *et al.*, 2006). Clough and Sears (1994) claim that any major variations or additions in the design phase may increase the project total cost. Variation orders in the design stage always lead to poor performance whether they are owner-initiated or consultant-initiated (Oladapo, 2007). Koskela *et al.*, (2000) cite a study carried out by Sverlinger (1996), which found that change orders are one of the most frequent causes of severe deviations during design.

Variation orders can be reduced at the design phase by providing good documentation, drawings and specifications. Nevertheless, good design does not necessarily involve high cost, as it will provide value for money in terms of total cost and cost-in-use

(OGC, 2007). Arain (2005) identified the design phase as the most likely area on which to focus to reduce the variations. On the other hand, variation orders during construction phase have much greater impact on a construction project's progress than variations during design phase. However, variations can be reduced at the construction phase as well, by having good management practices, such as communication and cooperation among project team members.

As a matter of fact, clients who spend more time and money in the design stage issue less variation orders (Ndihokubwayo, 2008). According to Arian and Pheng (2007) when variation orders are studied comprehensively at early stages, this can minimize problems in construction projects and beneficial variation orders can be conducted. Here, a study conducted by Langford *et al.* (1986 cited in Akinsola, 1997) states that the design team initiates 72% of the variation orders. Another study by Oladapo (2007) found that that clients and consultant initiate the majority of the variation orders.

This research concentrates on any variation order in the entire design process that affects the agreed time, cost and quality of the design or the construction stage. The reasons behind that, are that the design stage has a high likelihood of variations occurring, so more focus on this stage is required to manage the variation orders. Changes at this stage require the engagement of the stakeholders to ensure effective management in applying them. Moreover, these variation orders need the public client approval to be implemented. However, the first phase of the design stage (*Briefing*) is beyond the scope of this research as it deals with collecting and confirming data about the client's requirements.

#### ***2.10.1 The design process in the Saudi construction industry***

In the common practice of the design process in Saudi public construction projects, the public client appoints a consulting firm to fully develop and complete the construction documents. However, according to Mohammed (2007) no formalized approach is applied for public clients to appoint a consulting firm. Mostly, design firms are approached by public clients because of their reputation in the market or through recommendation of the client's representative. With regard to the systems adopted in Saudi consulting firms, according to Abolnour (1994), each design firm in Saudi Arabia selects an international system which is compatible with their engineers, the nature of the project and their clients.

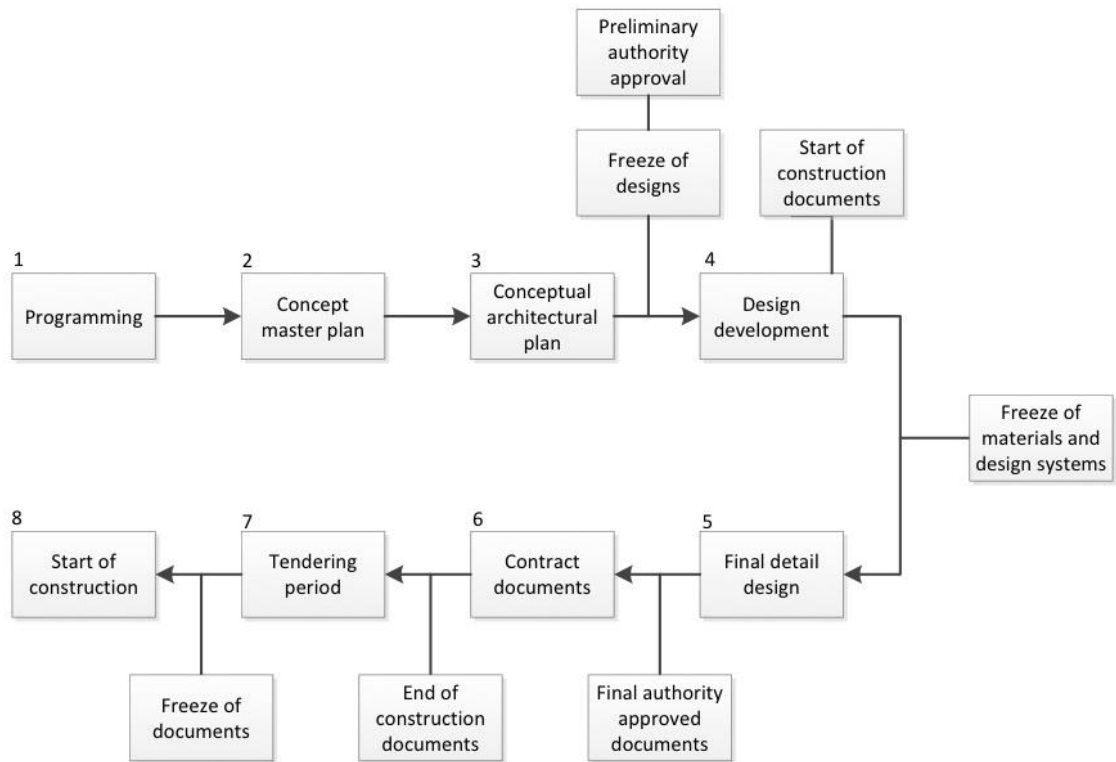
A study was conducted by Mohammed (2007) to investigate the existing systems of the design process in the Saudi construction industry. According to this study, the practices of the American Institute of Architects (AIA) and the Royal Institute of British Architects (RIBA) are the most well-known practices in the Saudi construction industry for the design process. This is owing to the lack of any comparable organisation in the Saudi construction industry providing a model of the design development. Instead, consulting firms apply a recognised existing practice, which is typically either that of the AIA or RIBA, depending on the background and experience of the design management.

Mohammed's (2007) study categorises the common practice of the design process in the Saudi construction industry into four main stages as follows:

- *Briefing (Programming)*: this stage covers the pre-design phase;
- *Sketch plans (master plan, preliminary stage:)* this stage covers the site analysis phase and schematic design phase;
- *Working drawings (design development phase)*; and
- *(Contract Document Phase)*: in some cases, Saudi design consultants use two stages to obtain the output of this phase. These two stages are the final design stage (which includes all types of drawings) and the construction documents stage (which includes contract, specifications, bills of quantities and any other required documents).

Figure 2.3 summarises all stages of the design process and producing the construction documents relating to AIA, RIBA and Saudi practice.





**Figure 2-3 Design process**  
**Source: Mohammed (2007)**

### ***2.10.2 The impact of poor design on project performance in the Saudi construction industry***

A study carried out by Arain *et al.* (2006) concluded that the inconsistencies between design and construction have a negative impact on the performance of construction projects in Saudi Arabia. They also identified a number of factors that have led to this matter, including the involvement of the designer as a consultant, communication gaps occurring between the contractor and designer, insufficient details in the working drawings and a lack of coordination between the parties. In addition they identified the lack of qualified human resources in the design firms, the designer's lack of knowledge of available materials and equipment and the use of incomplete shop drawings and specifications.

Arain *et al.* (2002) suggest that the clients' inexperience led to the adoption of inadequate designs, resulting in many changes to drawings, specifications and contract terms, and therefore, failure in project performance. They also recommend that, in order to achieve maximum project performance, there must be a significant presence and participation of the designer in both the design and construction phases. Al-

Mansouri (1988) found that, in the Saudi construction industry, time limitation in the design stage may occasionally force the designer to deliver the necessary design works at a lower quality. According to Arain *et al.* (2006), if insufficient time is given to the designer, the design cannot be developed in a proper manner. This issue may eventually cause misunderstandings among engineers working on the project.

A study conducted by Al-Dubaisi (2000) found that variation orders are the major cause of failure in construction project performance in Saudi Arabia, because they lead to cost and time overruns. The results of the study indicated that cost overruns because of variation orders were in the magnitude of 6% to 10% of the original contract value, whereas time overruns due to variation orders were reported as being less than 10% of the original contract period. The study also concludes that the clients initiate most changes during the design phase. Furthermore, design errors are considered as the most important cause of variation orders in large building projects in Saudi construction industry. Mutaawaa (1988) found that insufficiencies in the design and construction stages, financial abilities and the behaviour of the construction parties were the most frequent causes of variation orders in Saudi construction industry.

The quality management in the design and construction stages is a key factor to achieve a successful project. In this regard, Al-Abdulrazzak (1993) asserts that quality management practices in the design phase, such as drawing checks and the provision of clear, concise and uniform plans and specifications have a significant impact on project performance. This is further explained by Bubshait *et al.* (1999), who identify the aspects influencing quality activities in design firms as (a) the major need for development in the quality of the working relationship part, (b) the need to overcome design errors that affect project performance, specifically, staff training and performance quality audit. Moreover, the study also identified an important need to launch a design code and assessment of performance of design firms in Saudi Arabia.

Al-Musallami (1992) reports that clients in his study were dissatisfied because of the high percentage of variation orders due to design errors, which have a significant impact on project performance. Assaf and Al-Hejji (2006) identify reasons for failure in construction projects in Saudi Arabia. Their results indicate several factors relating to design that affect project performance. These factors include: “*mistakes and discrepancies in design documents; delays in producing design documents; unclear and*

*inadequate details in drawings; the complexity of project design; insufficient data collection and surveying before beginning the design; misunderstanding of the client's requirements by the design engineer; inadequate design-team experience; and the non-use of advanced engineering design software”.*

Based on the findings of the above researchers, it can be clearly seen that variation orders in the design stage are one of the major sources of poor design and failure in delivering construction projects successfully in Saudi Arabia. This failure can be considered as due to mismanagement of variation order implementation.

### **2.11 Source of occurrence of variation orders**

It is only clients and consultants who are involved in the design stage for projects that use the traditional procurement route, and contractors are not involved in this stage. Ssegawa *et al.* (2002) argue that the most common source of the occurrence of variation orders are *the client* and *the designer*, due to financial problems, errors in the design and changes in the drawings. Hence, the clients and consultants will be the scope of this study.

There are two types of clients in the construction industry, experienced clients and inexperienced clients, with little or no experience. Experienced clients, during the design phase, provide professional guidance and assistance to the design team. This involvement of the client may lead to the avoidance of change orders occurring during the construction phase. In contrast, inexperienced clients depend on the guidance of the design team and do not have a clear scope in their requirements. The consultant team usually includes architects, designers, specialist engineers, quantity surveyors and project managers. Team members of the consultants have the influence to minimize the occurrence of variation orders in the design stage (Ndiokubwayo, 2008).

A study conducted by Longford *et al.* (1986) found that the design team initiates 72% of the variation orders in the design stage. A similar study by Oladapo (2007) emphasises that clients and consultants initiate the majority of the variation orders. Further research by Alnuaimi *et al.* (2010) indicates that clients initiate most of the variation orders in the design stage in Oman.

This substantial amount of variation orders in the design stage, whether by public clients or consultants, leads this research to focus on these parties to the construction projects. An effective variation order management process is required to avoid any potential design errors, poor implementation of variation orders and conflicts and disputes among stakeholders, in both the design stage itself and in subsequent stages.

## **2.12 Management of variation orders**

Due to the inevitability of variation orders as well as their potential impact on the planning, design, progress and completion of any given construction project, it is not uncommon in the research community to devote considerable effort and time to the experimentation on and theorisation of how such orders can best be managed (e.g. Arain, 2005, Stevens, 2005, Arain and Pheng, 2005, Krone, 1991). In this respect, Arain (2008) claims that *“the issue of managing variations has received much attention in the literature. Despite many articles and much discussion in practice and in the academic literature, the issue of learning from past projects in making timely and more informed decisions for the effective management of variation orders has not been explored much in the literature”*.

In fact, several strategies have been acknowledged as useful in managing variation orders. According to Charoenngam *et al.* (2003), among the various strategies used to manage variations is that of involving the creation of good communication and cooperation among project team members. In making information accessible to all stakeholders, they further advise making good use of the internet technology as the communication medium where accessibility to timely and accurate information is not bound to time and place. Jacob (1978: 64–65) noted that *“lax attitudes and unfamiliarity with proper change order procedures have led to serious financial loss and insolvency”*, while Chan and Yeong (1995) assert that good contract documentation as well as good communication and cooperation between building team members are major elements that can make the task of managing change orders easier. Chan and Yeong (1995) explain that good documentation it is generally facilitated by designing an effective change order system, geared towards understanding the change order process or *“workflow”*, which can be collected from the standard forms of contract. With regards to good communication, however, this might be facilitated by providing information in a well-timed procedure.

In a similar manner, Krone (1991) suggests *a variation order process* in which efficient administrative processing is promoted. Krone's (1991) process claims to address the day-by-day demands of changes in the construction process. Here, CAT, i.e. the contractual analysis technique suggests that initial announcement and submission of proposals helps to maintain management control and avoided impact claims. Although CAT paved the way for future contract variation clauses in construction management, such a proposed process was bound to the administrative processing and addressing only the day-by-day demands of variations in the construction process. Another proposed methodology is FACD, functional analysis concept design, by which clients and designers can collaborate during the design stage of projects to reduce the number of variation orders in construction projects (Stocks and Singh 1999). According to these authors, FACD is a practical method that could reduce construction costs overall. Charoenngam *et al.* (2003) developed and utilized a web-based application for managing change orders in construction projects that supports documentation practice, communication and integration between different team members in the change order workflow. CIRIA (2001) published a best practice guide to best practice recommendations for the effective management of change on construction projects. This published guide suggested three change processes for changes in the design stage, post-fixity changes that are urgent and post-fixity changes that will be applied during the remainder of the project process. Arain (2008) presents a knowledge-based decision support system (KBDSS) for the management of variations. The KBDSS is able to assist project managers by providing accurate and timely information for decision-making.

Following a similar line of thought, Arain and Pheng (2007) developed a theoretical framework, based on the six basic steps of variation orders identified by CII (1994b), to make more informed decision for managing variation orders in construction projects. The theoretical framework comprises six steps, which are:

- *identify variation for promoting a balanced variation culture;*
- *recognize variation;*
- *diagnosis of variation;*
- *implement variation;*
- *implement controlling strategies; and*

- *learn from past experience*

Arain and Pheng (2007) adopt the theory of dominance structuring, devised by Montgomery (1983), which proposed a pre-decisional information search, passing through three stages, which are:

- *screening;*
- *choice of a promising alternative; and*
- *dominance building.*

These three stages are further categorized into three sub-stages of a theoretical framework for managing variation orders, as suggested by Montgomery (1983).

In a similar manner, a study carried out by Motawa (2004) presents a systematic approach to modelling the change process in the construction industry. The study represents the key decisions to implement changes by developing a model to analyse and build on the outcome of previous research carried out by the author. The developed model is a generic change process model that can be implemented for different change types, for example pre- or post-fixity changes.

The developed model consists of four main parts, which are:

- (1) *Pre change stage:* At the first stage of the model, the generic process identifies a set of proactive requirements that are vital for effective management of change. The identified requirements enable the project members to respond easily to change, to facilitate plans for any unexpected changes and to manage changes effectively. The main proactive requirements are as follows:
  - a. *Allocate resources for change management function*
  - b. *Initiate and select change management process for project*
  - c. *Approaches towards change management*
  - d. *Align project elements to change management process.*

(2) *Identify and evaluate changes*: Full identification of change would assist the project team to evaluate the change. The model classifies change identification into four categories:

- a. *Monitor deviations from project programme*
- b. *Analyse and consider implications of identified deviations*
- c. *Develop mitigation strategy for change event*
- d. *Update change management repository*

Evaluation and analysis of change is required for decision-making, whether to go ahead with the change or to conduct further investigations. The analysis of the change should cover each single aspect of the project performance.

(3) *Approval and propagation*: Approval by the client is an essential step in the generic change process. The potential change needs to be reviewed by the client in order to approve or reject the change, in some cases clients need to use decision-making approaches.

(4) *Post change stage*: After implementing the change, the change should be analysed and archived for future projects. Knowledge and lessons learnt from the change should be kept for all project members. The negative impact of future changes can be minimised when the project members can experience knowledge gained from previous changes.

This model can be used to monitor the process of change implementation. Additionally, it can be used to diagnose changes when they occur. Motawa's (2004) study concludes that the likelihood of change occurrence at the early stage of construction projects is high. That means more concentration is needed at the first stages to minimize the changes.

Similarly, The Construction Industry Institute (1994b) and Ibbs *et al.* (2001) introduced CMS, change management system, which is a two-level process model, with principles as its foundation, and management processes to implement those principles. The model aims to introduce a system to overcome or minimize delays, cost overruns and general claims associated with project changes. The research team hypothesized that considerable savings in the total cost and duration of any construction project were

achievable by developing change management systems. The established model was based on five main principles. These principles can be summarized as:

- (1) Promote a balanced change culture;*
- (2) Recognize change;*
- (3) Evaluate change;*
- (4) Implement change; and*
- (5) Improve from lessons learned.*

However, CMS was subject to much criticism on the basis that it lacked the basic principle and process of implementing controls for future variations in construction projects. Nevertheless, most of these models have their benefits and drawbacks, and the while one might be suitable to one project, it might not be practical for another. However it can be generally claimed (Charoenngam *et al.*, 2003) that success in managing change orders results in uninterrupted construction operations and an agreed final project cost and duration.

The above review of the different approaches has revealed that in existing models in construction industry, little or no attention has been paid to the significance of linking stakeholder engagement and the variation order management systems. Moreover, in the existing construction research, no attempt has been made to identify and highlight the stakeholders' key characteristics during the variation order management process. This lack of acknowledgement of stakeholder engagement has led to shortcomings and failure to manage variation orders effectively. Most importantly there is no single study that addresses the current practice of variation order management in the Saudi construction industry. These issues will be strongly confirmed later on in Chapter 5, from the exploratory interviews.

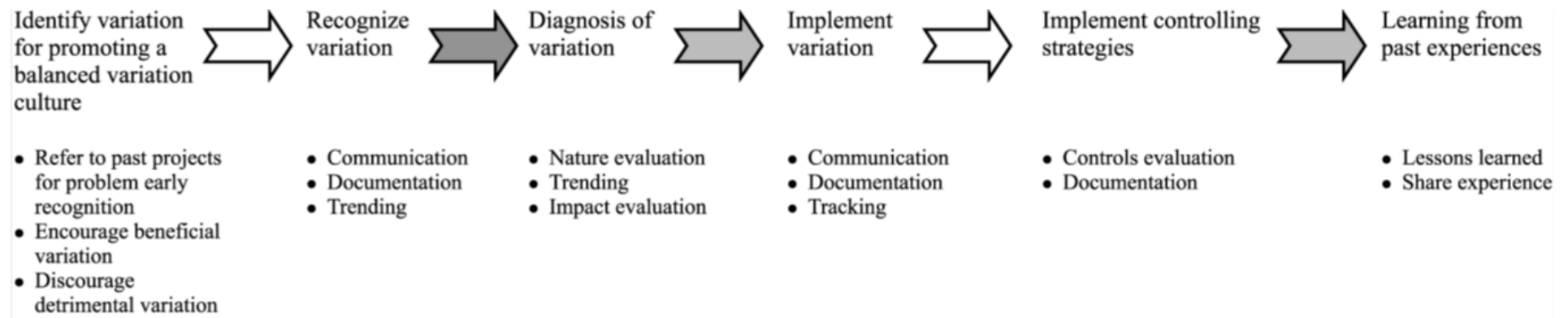
#### ***2.12.1 Fundamentals of variation management systems***

From the different systems of variation order management described in section (2.12), it can be argued that the basic principles of any system to manage variation orders are to anticipate, recognize, evaluate, resolve, control, document and learn from past variation orders. Arain and Pheng (2007) propose six basic principles to manage variation orders



effectively. These principles are adapted from CII (1994b) and presented in Figure (2.4). The six basic principles are:

- (1) identify variation for promoting a balanced variation culture;*
- (2) recognize variation;*
- (3) diagnosis of variation;*
- (4) implement variation;*
- (5) implement controlling strategies; and*
- (6) learning from past experience.*



**Figure 2-4 Basic principles of variation order management systems**  
Adapted from CII (1994b)

### 2.13 Taxonomy of Variation Orders

Generally speaking, a taxonomy is identified as a “*process or a system of organizing things into different groups that show natural relationships*” (Longman Dictionary, 2007). Theoretically, the development of a taxonomy takes into consideration the importance of separating components within groups. Sun and Meng (2008) carried out a study into the taxonomy of change causes and effects in the construction industry, to fill a knowledge gap, by: (1) reviewing the existing literature on project change causes and effects; (2) developing two taxonomies for change causes and effects and (3) showing how these taxonomies can be used.

At that time of the abovementioned study, 101 papers were found on variation orders in the construction industry. These publications covered most of the research areas worldwide. Sun and Meng (2008) categorised variation order papers in terms of paper source, published year, country of the study and research method. Subsequently, these papers were categorised into three groups, as follows: (1) papers addressing change causes, (2) papers addressing the impact of the changes (3) and papers addressing both causes and impacts of changes.

Similarly, Alsuliman and Bowles (2012) developed another taxonomy of variation orders in the construction industry. , However, the developed taxonomy focuses on a different perspective with regards to the purpose, methods of data collection and results. This study, carried out by the present author, was intended to support the theory of the present proposed research and assist in producing a solid base for managing variation orders in construction projects. To achieve that, Alsuliman and Bowles (2012) carried out a preliminary review and found numerous papers on the proposed research area. The majority of these papers fall into two main groups: group (A) deals with the causes and impact of variation orders and those in group (B) are about managing variation orders. Both groups have been divided into three categories in terms of the research purpose, the methods and the results of these studies.

The most common purpose of the papers in group (A), which deal with the influences of variation orders in the construction industry, is to determine the types and causes of variation orders. The majority of these studies deal with particular construction projects and countries, such as the research by Alnuaimi, et al. (2010), Oladapo (2007),

Ndihokubwayo (2008), Moselhi, et al. (2005), Ssegawa, et al. (2002) and Arain and Pheng (2005a).

The methods used in most of the papers in group (A) were questionnaires, interviews and case studies, where the researchers wished to determine the impact, types and causes of variation orders, in particular, across a small number of construction projects. The results of these studies demonstrated that variation orders have a significant negative impact on the project progress and performance, in terms of time, cost and quality. Moreover, in some cases, variations led to disputes and conflicts between the project parties.

In group (B), researchers such as Motawa, et al. (2007), Arain and Pheng (2005; 2007), Hassanein and El Nemr (2007), Hao, et al. (2008), Senaratne and Sexton (2009), Arain (2005), Motawa (2004) and Charoenngam, et al. (2003), aimed to manage variation orders, in order to minimise the frequency of change orders and to avoid the associated problems. In addition, they sought to speed up the processes of obtaining a change order, to save time and money.

In order to achieve these objectives, the researchers attempted to create a database, develop a model or implement a change order management system (COMS) to deal with a large number of construction projects and to manage variation orders effectively. However, these methods require comprehensiveness and quality in the project records used (Sun and Meng, 2008). The results of the research indicate that good communication, co-operation among the project teams, good contract documentation and learning from similar past construction projects will assist in reducing the frequency of detrimental change orders. Table (2.1) shows a summary of the taxonomy of variation order research in terms of impact and management.

**Table 2.1 A summary of the taxonomy of variation order research****Source: Alsuliman and Bowles (2012)**

Type of study	Purpose	Method	Results
Group (A): Impact of variation orders	1-Types of variations e.g. (Arain and Pheng, 2005a) 2- Causes of variations e.g. (Oladapo, 2007)	1-Questionnaire (Alnuaimi <i>et al.</i> , 2010) 2- Interview Hassanein and Elnemr, 2010) 3- Case study (Oladapo, 2007)	Variation orders have a significant negative impact on the project progress (Alnuaimi <i>et al.</i> , 2010 and Oladapo, 2007)
Group (B): Managing variation orders	1-Speed up the process (Arain and Pheng, 2007) 2- Minimize variations (Arain and Pheng, 2005) 3- Avoid problems Hassanein and Elnemr, 2010)	1- Creating a database (Charoenngam <i>et al.</i> , 2003) 2- Developing a model (Motawa, 2004) 3- Implementing COMS (Motawa <i>et al.</i> , 2007)	1- Good communication (Arain and Pheng, 2007) 2- Cooperation (Charoenngam <i>et al.</i> , 2003) 3- Good contract (Hao <i>et al.</i> , 2008) 4- Learning from past projects (Arain and Pheng, 2005)

The taxonomy developed by Alsuliman and Bowles (2012) can be used to review different construction projects and used as a framework by project teams to ensure all key factors related to variation orders are covered. In addition, this taxonomy can assist the project team in dealing with managing variation orders efficiently by understanding the importance of having good communication skills, good co-operation among the project parties and well-written contract documentation. Additionally, reviewing and evaluating the most common causes and types of variation orders from past similar construction projects will help the project members to deal with variation orders effectively.

## 2.14 Summary

This chapter considered the concept of variation orders in more depth, and showed that they can have a negative impact on the design performance and even the construction stage. Moreover, it discussed a number of the well-known causes and impacts of variation orders, from the existing studies. It is clear that, the complexity of the nature of a construction project leads to the occurrence of high number of variation orders, even in the case of the most thoughtful and well-planned projects, and these arise more in complex and large projects. ], The issue of the different influences of different procurement routes on the occurrence of variation orders was also considered, particularly the differences between traditional and non-traditional procurement routes. The procurement routes and regulations in Saudi public construction projects were reviewed with more emphasis on the traditional method, as this is the one most employed in the public sector.

The chapter then discussed the occurrence of variation orders in the design stage and pointed out that the design stage is the one with a higher likelihood of variation orders occurring. The current design process and practice in Saudi construction industry were addressed. A study of the literature revealed that both clients and consultants are known as the most likely source of variation orders. Several strategies have been acknowledged as useful in managing variation orders and some of these important strategies were described to provide in depth understanding of the existing conditions for variation order management to assist the researcher to contribute to the proposed model development.

This chapter found that, in construction research, no attempt has been made to identify and highlight the stakeholders' key characteristics during the variation order management process. This lack of acknowledgement of stakeholder engagement has led to shortcomings and failures to manage variation orders effectively. This is further discussed in the following chapter. Finally, two different taxonomies for the existing body of literature for variation orders were reviewed. The first one included the causes and impact of variation orders in the construction industry. However, the second one, that was developed by the researcher to support the theory of the present proposed research and assist in producing a solid base for managing variation orders in construction projects, added management of variation orders to be included in the taxonomy.

## **Chapter 3 Stakeholder engagement in the construction industry**

### **3.1 Introduction**

In recent years, the interest in stakeholder management has grown, and scholars in the construction industry (e.g. Newcombe, 2003; Olander, 2006) have acknowledged the importance of stakeholder management and have paid more attention to it. This growth of interest has been expanded in different perspectives of stakeholder research. The absence of stakeholder engagement during the process of variation order management has led to shortcomings in managing variation orders. As this issue is reflected in the little attention paid to it in the existing body of literature, the researcher aims to provide a clear perspective of the relationship between the process of variation order management and stakeholder management as portrayed in the existing literature. This chapter reviews the existing body of literature on stakeholder management in the construction industry and classifies it in order to investigate whether there is a link between the stakeholder management and the process of variation order management or not. This chapter also investigates the level of stakeholder management and engagement in the current practice of variation order management in the Saudi public construction projects and how it can be improved.

### **3.2 An overview of stakeholder management**

It was established in Chapter 2 that the key characteristics of stakeholders during the variation order management process are not well identified in the construction research and that such shortcomings negatively influence the successful implementation of variation orders. Thus, this chapter will shed light on the existing body of literature on stakeholder management in the construction industry. Furthermore, the researcher will explore in depth the degree of stakeholder engagement in the existing variation order management systems, to shape the subsequent development of the data collection stage.

According to Weiss (2006) a stake is a share or an interest in a project whilst a stakeholder is an individual with a stake. Stakeholder as a term is defined by Freeman (1984) as “any group or individual who can be affected by the achievement of the firm’s objectives”. Moloney (2006) defines stakeholders as groups or individuals that benefit from an organisation. Stakeholders influence and are influenced by an organisation and

its activities. They can influence an organisation's aim, functioning, development, performance and even survival. Moreover, stakeholders can be beneficial to an organisation, when they assist it in achieving its goals; they can also be detrimental when they oppose the organisation's mission. Fundamentally, stakeholders have power to be either a benefit to an organisation or a threat (Gibson, 2000).

Stakeholders' impact can be either small or great and can be exerted incidentally or deliberately. Chinyio and Olomolaiye (2010) argue that organisations and individuals within them need to be wary about their stakeholders and their impact. Hence, stakeholders must be managed effectively in each project, to overcome their possible negative impacts. Different stakes in a project can be a major source of conflict between stakeholders; thus it is essential to manage stakeholders effectively (Chinyio and Olomolaiye, 2010).

Based on these perceptions, a number of stakeholder theories are well documented in the literature (Hill and Jones, 1992; Gibson, 2000). Furthermore, several stakeholder management process models have been established (Savage *et al.*, 1991; Freeman, 1984). The aim of stakeholder management is to identify the various views of different parties, clarify stakeholders' needs and improve communication among them (Freeman, 1984).

### **3.3 Stakeholder management in the construction industry**

Recently, researchers in the construction industry (Newcombe, 2003; Olander, 2006) have realised the significance of stakeholder management in construction projects and have paid more attention to this issue. As any construction project consists of various complex activities, each stakeholder has different levels of interests and powers in the project they are involved in. Bourne (2005) states that the project's success or failure is strongly affected by both the perceptions and expectations of the project's stakeholders. According to Karlsen (2002) poor management of stakeholders can cause many negative impacts in construction projects, such as *“poor scope and work definition, inadequate resources assigned to the project (both in terms of quantity and quality), poor communication, changes in the scope of work and unforeseen regulatory changes”*.



The number of stakeholders in any construction project is often large and would include *“owners and users of facilities, project managers, facilities managers, designers, shareholders, legal authorities, employees, subcontractors, suppliers, process and service providers, competitors, banks, insurance companies, media, community representatives, neighbours, the general public, government establishments, visitors, customers, regional development agencies, the natural environment, the press, pressure groups, civic institutions, etc.”* (Newcombe, 2003; Smith and Love, 2004). As this study deals mainly with public construction projects in Saudi Arabia, the clients, public sector bodies, can be also considered as stakeholders in other ways, as they obviously affect individuals and organisations through their regulatory policies and authorities. Moreover, the public sector could have an interest in the operation and existence of particular organisations. The next two sections are devoted to examining the types of stakeholders, relationships among stakeholders, stakeholder communication and the culture and interaction of stakeholders, in order to provide a clear perspective of stakeholder characteristics that could help to solve the major problems in managing stakeholders.

### ***3.3.1 Types of stakeholders***

In stakeholder management, types of stakeholders are identified and classified in order to facilitate both initial and subsequent engagement with stakeholders, in a timely, coordinated and planned manner. Cleland (2002) states that stakeholder engagement involves *“identifying different categories; gathering information about them; identifying their missions; predicting their behaviour and developing and implementing a strategy for managing these stakeholders”*.

According to Chinyio and Olomolaiye (2010), stakeholders have been grouped by different criteria and some of these criteria are discussed below:

- According to Calvert (1995) and Winch and Bonke (2002), the stakeholders in a project can be divided into:
  - Internal stakeholders, that is, those who are involved in the project or who provide finance (e.g. clients, consultants and contractors).
  - External stakeholders, that is, those influenced by the project in a significant way (e.g. neighbours, government authorities and local community).

- Stakeholders can be internal or external to the project team or project scope (Sutterfield *et al.*, 2006).
- Other classifications are inside and outside stakeholders (Newcome, 2003).
- Similar types of stakeholders are direct and indirect (Smith and Love, 2004).
- A different classification is into primary and secondary stakeholders (Carroll and Buchholtz, 2006).

### **3.3.2 Relationship management for stakeholders in construction industry**

In recent years, large numbers of researchers have come to believe that stakeholder relationship management is imperative in the construction industry. Cleland (1986) and Jergeas *et al.* (2000) believe that a well-organised management of the relationship between the stakeholders and their project is a significant key for the project to be successful. Similarly, Aaltonen *et al.* (2008) believe that the key issue to successful project stakeholder management is the efficient management of the relationships between the project and the stakeholders themselves. Charoenngam *et al.* (2003) further explain that, making information accessible to all stakeholders would help them to manage variation orders effectively. Hartman (2002) considers that efficient project relationships are crucial to deliver any project successfully and to meet the stakeholders' expectations. Olander (2006) counts stakeholder management in construction projects as a system; he also considers that the different elements of stakeholder management must be examined, with the relationships between these elements. Unlike the traditional project management approach to the stakeholders, many recent researchers have taken the relationship between stakeholders into consideration (Cova and Salle, 2006).

Yang *et al.* (2010) categorise the literature on relationship management in construction into two different categories, which are “(a) *the promotion of the relationships between different project participants and the analysis of the importance of relationship management* and (b) *the analysis of the impact made by stakeholders through an informal ‘instrument’, the network of relationships*”.

### **3.3.3 Communication and culture in stakeholder management**

The survival of any organisation depends on its capability to develop, support and maintain efficient and continuing relationships among its stakeholders. In fact, effective

communication with stakeholders is imperative to the success of any project in any organisation. A good communication process assists in maintaining good relationships between stakeholders and their organisations (Al-khafaji *et al.*, 2010). Similarly, Bakens *et al.* (2005) and Young (2006) emphasise that the key factor to good stakeholder management is effective communication. Landin (2000) believes that the good performance of any construction project and the ability to satisfy the stakeholders relies on the care taken and the decisions made by the decision makers in promoting stakeholder communication. Stakeholder engagement must result in valuable outcomes by those involved and must be communicated in an appropriate approach. Interviews carried out by Jergeas *et al.* (2000) identified two factors for improvements for the management of stakeholders, which are, (a) *communication with stakeholders and setting common goals*, and (b) *objectives and project priorities*.

There is an argument that states that there are different techniques to manage stakeholders, depending on the cultures of individuals, organisations and the industry. In fact, culture has a great influence on the stakeholders' thinking and decision-making. It is obvious that the style of managers/leaders and analysis of the variety of cultures at the organisational, industry or social level will have deep implications on the practice of managing stakeholders (Elmualim, 2010).

### **3.3.4 Interaction of stakeholders**

The stakeholders in the construction industry are not isolated from each other. Stakeholders are closely interrelated, through either formal or informal relationships during the implementation of a construction project process. The internal stakeholders in a construction project are linked through legal contracts, for instance, a consultancy agreement between a client and a consultant (Leung and Olomolaiye, 2010). Generally, clients, consultants and contractors have official procedures, as they are closely linked via legal contract ties.

This section focuses on the initial, pre-design and design stages, due to the limited scope of this study, which deals only with clients and consultants at the design stage. Firstly, in the *initial stage* of a construction project, the client commonly appoints consultants to prepare a marketing report to assist the client to fully understand the market needs and the existing economic situation. In this stage, public sector clients

may not have any financial problems as to whether to go ahead with the project or not (Leung and Olomolaiye, 2010).

Secondly, in the *pre-design stage* of a construction project, clients usually appoint consultants as internal stakeholders for further investigation of the project. In this stage the project manager, the architect, the quantity surveyor and the engineers have to work together on a feasibility study, as a group of internal stakeholders, in order to guarantee the project will be constructed and operated as planned and designed. As the details of the project are not fully provided and clear in this stage, it is difficult for designers to assess and identify the technical problems and for quantity surveyors to estimate the project budget. Moreover, there may be some further conflicts amongst consultants at both the pre-design stage and design stage, as each consultant in this stage concentrates on his/her specific area: (for example, the architects focus on aesthetic design, the structural engineers on the structural system and the surveyors on the cost saving (Leung and Olomolaiye, 2010). Hence, the client needs to make decisions about several important aspects in the project such as the scope of the project work and the investments in the development, design considerations, financial conditions, project costs and duration.

Thirdly, in the *design stage*, clients and consultants have to work hand-in-hand to make sure the design is satisfactory. In this stage, clients usually choose one or two proposal(s) based on the suggestions from the feasibility report (RIBA, 1991). In this stage, the project manager will cooperate with other consultants in order to review the approved proposal in detail and make an initial design for the project, based on the client's needs. Leung and Olomolaiye (2010) argue that during the design stage, constant and frequent communication is vital. Furthermore, all the conflicts and technical issues between different types of project disciplines must be resolved by the design consultants. Delays in approvals by the client may cause the project to be delayed. An important issue to be considered by the project manager is to provide frequent reports to the client, in order to give a clear picture of the design progress, overcome design errors and avoid design conflicts between the client's needs and consultants' opinions and ensure an accurate time and cost estimations of the project.

### 3.4 Stakeholder mapping

The aim of every stakeholder mapping process is to develop an effective list of stakeholders. This development would measure some of the stakeholders' key features and present these measurements in an approach that assists the project team develop understanding in order to support their implementation of proposed stakeholder management initiatives. According to Bourne and Weaver (2010), the key factor of an effective mapping process is to make the assessment process transparent and to replace subjectivity with objective measures. The transparency will facilitate review and updating and will allow the basis of the assessment to be fully understood by the stakeholders.

The importance of stakeholders is directly associated with their ability to affect the project through their relationships. The only difference in the analysis is in the method how the importance is assessed (Bourne and Weaver, 2010). All the stakeholder mapping techniques discussed below use a qualitative perception of a stakeholder's importance rather than using a qualitative analysis of the influence networks and relationships of the stakeholder to identify a value for each stakeholder's importance.

Bourne and Weaver (2010) cite the following list that identifies some of the most commonly applied and best known methods for mapping stakeholders:

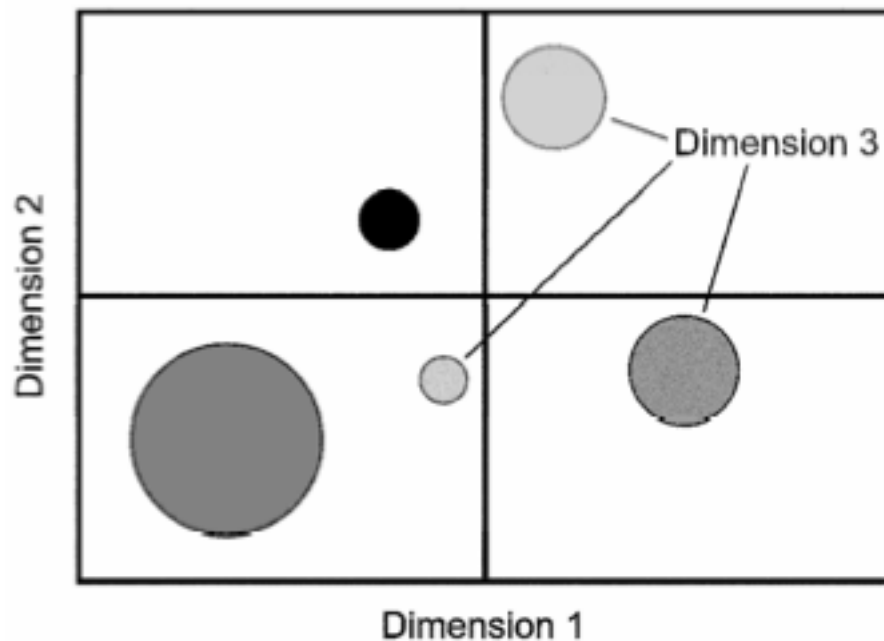
- Mitchell *et al.* (1997) developed a categorisation of stakeholders depending on the power to influence, the authority of each stakeholder's relationship with the organisation and the importance of the stakeholder's claim. The results of the categorisation may assess the key question of "*which groups are stakeholders deserving or requiring manager's attention, and which are not?*" (Mitchell *et al.*, 1997: 854).
- A process for mapping stakeholder expectations is defined by Fletcher *et al.* (2003) based on value hierarchies and Key Performance Areas (KPA).
- Another classification, by Savage *et al.* (1991), presents a method to classify stakeholders depending on *potential for threat* and *potential for cooperation*.
- Turner *et al.* (2002) proposes a process of identification, assessment of awareness, support and influence, leading to strategies for assessing stakeholder

satisfaction and communication and who is ignorant or aware and whether the stakeholders' attitude is opposing or supportive.

Stakeholder mapping includes the following sub-set of methods:

- Influence-interest grid (Imperial College London, 2007);
- Power-impact grid (Office of Government Commerce, UK 2003);
- Power-interest grid (Moorhouse Consulting, 2007) and
- Three-dimensional mapping of interest, power and attitude (Murray-Webster and Simon, 2007).

The most commonly used presentation style is a matrix to represent two dimensions of interest; sometimes a third dimension is used to present the individual stakeholders. The dimensions of interest are presented in Figure 3.1.



**Figure 3-1 The traditional stakeholder mapping**  
**Source: Bourne and Weaver (2010)**

According to Bourne and Weaver (2010) the most commonly used dimensions are as follows:

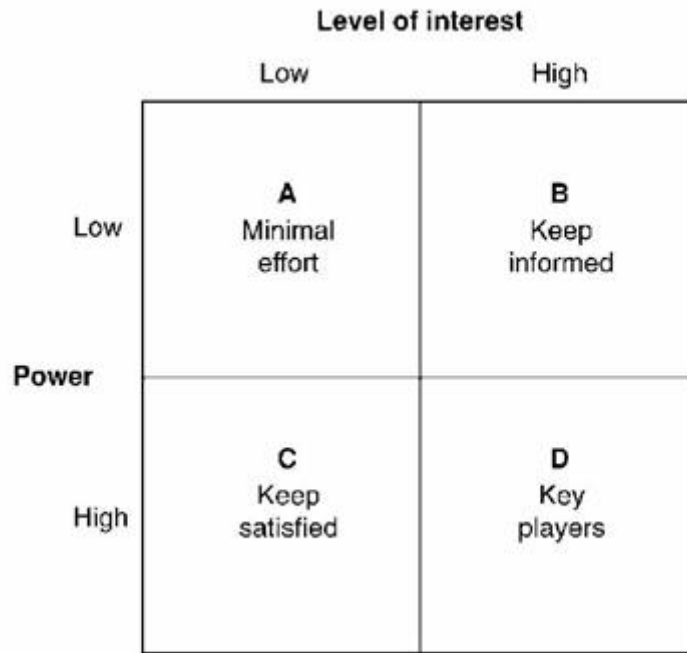
- Power (high medium low);

- Support (positive, neutral, negative);
- Influence (high or low);
- Interest (high or low) and
- Attitude (supportive or obstructive).

### **3.4.1 The power/interest matrix**

Several stakeholder mapping techniques have been established, for instance by Johnson and Scholes (1999), McElroy and Mills (2000) and Mendelow (1981). However, the most common technique of mapping stakeholder impact is the power/interest matrix, which is shown in Figure 3.2. Johnson and Scholes (1999) designed this matrix, which categorizes stakeholders in terms of the level of power that they have and their level of interest in the project. The type of communication and relationship that the project manager requires to establish and maintain with the different types of stakeholders is illustrated for each type of stakeholder in four zones in the matrix. Johnson and Scholes (1999) defined power as *“the ability of individuals or groups to persuade, induce or coerce others into following certain courses of action”*. According to them, the power/interest matrix describes the context within which a strategy might be pursued by classifying stakeholders in relation to the power they hold and the extent to which they are likely to show interest in supporting or opposing a particular strategy.

In this matrix, stakeholders with low level of interest in the project activities and low level of power to affect the project activities are in (Zone A), as they just need minimal effort from the project manager.



**Figure 3-2 Stakeholder mapping: the power-interest matrix**  
**Source: Johnson and Scholes (1999)**

Stakeholders in Zone B with a high level of interest in the project activities but low level of power to affect project activities require to be kept fully informed of the major decisions that have been made; hence, good communication with this type of stakeholder is crucial.

Those stakeholders in Zone C require to be kept satisfied, as they have a high level of power to influence the project activities, but with little interest in the project's activities. In fact, stakeholders in Zone C are often the most difficult type of stakeholders to manage. Finally, stakeholders with a high level of interest in the project activities and high level of power to affect the project activities are in Zone D, as they are key players for the project decisions. It is clear that the acceptability of decisions to the stakeholders in Zone D is an important consideration when formulating project plans.

Stakeholders in Zones A and B need to be monitored and managed because, although they have low level of power, they may have negative influence on the more powerful stakeholders. Stakeholders in Zones C and D represent different but equally significant problems (Newcombe, 2003). Olander and Landin (2005) state that by mapping stakeholders in the power/interest matrix, the project manager can provide a better



communication and relationships between stakeholders to influence the project and its implementation positively.

### **3.5 Classification of stakeholder management literature**

In recent years, researchers in the construction industry have realized the importance of stakeholder management in project outcomes, and recognition of the concept of stakeholder management has grown (e.g. Newcombe, 2003; El-Gohary et al., 2006; Olander and Landin, 2005). Consequently, the growth of interest in stakeholder management has been expanded in different perspectives of stakeholder research (Friedman and Miles, 2006). Some scholars have attempted to categorize these perspectives. Jones (1995) identified three main approaches to categorising stakeholder theory: *descriptive, instrumental, and normative*. According to Kolk and Pinkse (2006), stakeholder research focuses on three major themes: (a) *identifying the nature of stakeholders*, (b) *examining under which circumstances and how stakeholders influence organisational decisions and operations* and (c) *identifying different strategies to deal with stakeholders*. Another classification, by Bourne and Walker (2006), divides stakeholder theory into (a) *social science stakeholder theory*, (b) *instrumental stakeholder theory*, and (c) *convergent stakeholder theory*". However, Atkin and Skitmore (2008) recommend that stakeholder research should include application of the insights of the theory of stakeholders to the real field problems and differ from the area of pure research that concentrates only on the development of stakeholder theory.

Here, the researcher intends to highlight and categorise the core themes of stakeholder management in the construction industry after reviewing the existing body of literature. This categorisation aims to investigate in depth whether or not attention is paid to the relation between variation order management and stakeholder management. A preliminary review found a considerable amount of literature published on stakeholder management in the construction industry; these studies fall into a broad spectrum, covering the stakeholder management process, systems, needs, types, techniques, models and approaches. Given the large volume of the existing body of literature, there was a need to set a limit to the scope of the review. It was decided to focus on three main areas, which are (a) the needs for stakeholder management, (b) the approaches to stakeholder management and (c) stakeholder management models, because a good understanding of these issues is a prerequisite for effective management of stakeholders. Moreover, reviewing these areas particularly would shape the subsequent development

of the research, to explore if there is any relationship in the literature between the variation order management process and stakeholder engagement.

### ***3.5.1 Approaches to stakeholder management***

Several approaches proposed in the literature have been acknowledged as useful in stakeholder management. According to Yang et al. (2011), although these studies do not represent an entire picture of stakeholder management approaches, these approaches do present new perceptions of the stakeholder management process, and could facilitate the process. The approaches are listed below in Table 3.1, which includes the three common ones, the power/interest matrix, Stakeholder Circle methodology and social network analysis. Yang et al. (2011) state that these three approaches are significant in stakeholder management for the following reasons:

(1) The power/interest matrix is a common approach taken by many scholars (e.g. Newcombe, 2003; Olander and Landin, 2005). In the power/interest matrix, stakeholders are classified based on their levels of power and interest in the project. In this approach the project management team has to take into account each type of stakeholder in a different method, and employ different engagement approaches (Newcombe, 2003). Various approaches in Table 1, such as the stakeholder impact index, the stakeholder influence matrix and stakeholder interest intensity index, were designed and developed based on the basis of the power/interest matrix. Hence, the power/interest matrix is the fundamental one (Yang et al., 2011).

(2) The second approach is the Stakeholder Circle methodology, which is a relatively systematic approach for stakeholder management. This approach assists the project team to identify and classify a project's key stakeholders, to develop a proper engagement technique and communication plan to ensure that the requirements and expectations of the key stakeholders are clearly understood and effectively managed, and also to evaluate the effectiveness of the communication plan (Bourne, 2005).

**Table 3.1 The different approaches of stakeholder management****Source: Yang et al. (2011)**

<b>Authors</b>	<b>Approaches</b>	<b>Purposes</b>
Rowley (1997)	Social network analysis	Analysing stakeholder relationships
De Lopez (2001)	A two-dimensional matrix (the potential of stakeholders and the influence or power of stakeholders)	Classifying stakeholders; identifying stakeholders' influence
Winch and Bonke (2002), Olander (2006), Olander and Landin (2008), Chinyio and Akintoye (2008), Reed et al. (2009)	Power/interest matrix	Classifying stakeholders; analysing stakeholders' influence; analysing the change of stakeholders
Newcombe (2003)	Power/predictability matrix and power/interest matrix	Classifying stakeholders; analysing stakeholders' influence
Bourne (2005)	The Stakeholder Circle methodology	Classifying stakeholders; prioritizing stakeholders; visualizing stakeholders; developing strategies; monitoring effectiveness
Young (2006)	The stakeholder influence matrix	Analysing information of stakeholders; identifying stakeholders' influence
Olander (2007)	The stakeholder impact index	Analysing stakeholders' influence
Jepsen and Eskerod (2008)	Stakeholder commitment matrix	Analysing stakeholder commitment; analysing the change of stakeholders
Walker et al. (2008)	Stakeholder interest intensity index	Analysing stakeholders' influence

(3) While the power/interest matrix, the Stakeholder Circle methodology and other traditional approaches focus on the attributes of stakeholders, the social network analysis focuses on the relationships between stakeholders in a network. Any construction project is non-linear and complex in nature, so it is likely that the relationships between stakeholders will be complicated and dynamic. Pryke (2006) claims that traditional research analyses the relationship between project managers and stakeholders and ignores the engagement between stakeholders. A social network is described as a specific set of linkages among a defined set of persons (Mitchell, 1969). To Wasserman and Faust (1994, p. 4) the stakeholders in the network can be viewed as *“interdependent rather than independent, autonomous units”*. In this approach, the social network analysis considers the project environment as a system connected by different relationships, and can be applied for mapping the interrelationships between

stakeholders and their social behaviour.

It can be claimed here that all the approaches described above are considered as critical success factors for stakeholder management. However, as construction projects are dynamic and complicated, so one of these approaches might be suitable to one project, but it might not be practical enough for another.

### ***3.5.2 The needs for stakeholder management in the construction industry***

Previous researchers in the construction industry have studied the importance of stakeholder management, as summarised in Table 3.2, which provides some evidence supporting the need for stakeholder management. A construction project consists of a series of complex tasks. Multiple stakeholders have their different levels and types of powers and interests in the project. Bourne (2005) believes the project's success or failure is strongly influenced by both the expectations and perceptions of the project's stakeholders. In fact, poor stakeholder management in construction projects can cause many serious problems, such as: *"Poor scope and work definition, inadequate resources assigned to the project (both in terms of quantity and quality), poor communication, changes in the scope of work and unforeseen regulatory changes"* (Black, 1995). All of these problems may be the major cause of delays and cost overruns in the construction industry.

According to Cleland (1999), managing different stakeholders and maintaining an acceptable balance between their interests are imperative to deliver a project successfully. Olander and Landin (2005) state that negative attitudes by stakeholders to a construction project can severely obstruct its completion. Such obstruction will lead to cost overruns and delay, due to conflicts among the involved stakeholders and controversies regarding the design of the project and its implementation. Their study indicates that evaluating the demands and impacts of the stakeholders should be considered as a required and significant step in the lifecycle of any construction project.

**Table 3.2 The importance of stakeholder management****Source: Yang et al. (2009)**

<b>Researcher</b>	<b>The importance of managing stakeholders</b>
Mellahi and Wood (2003)	It is an important method for increasing the likelihood of achieving the marketplace success.
Clarkson (1995)	The corporation's survival and continuing success depend upon the ability of its managers to create sufficient wealth, value, or satisfaction for stakeholders.
Alexander and Buchholz (1982)	High levels of responsibility towards primary stakeholders can lead to lower explicit costs.
Caulkin and Black (1994); Kotter and Heskett (1992)	The performance of companies that balanced the interests of all their stakeholders is better than that of those which put their shareholders first.
Donaldson and Preston (1995)	Adherence to stakeholder principles and practices tended to achieve conventional corporate performance objectives better than rival approaches.
Preble (2005)	The mismanagement of stakeholder activist issues can result in lost markets and revenues, a decline in share prices, large legal fees, as well as wasted management time.

Yu et al. (2007) believe that managing stakeholders by employing surveys is an essential factor in the construction project briefing process, and they consider it is necessary to evaluate the individual stakeholder's commitment, interest and power prior to the briefing process of the project and to take into consideration the level of interest of each stakeholder. Olander and Landin (2005) emphasise that project managers should clearly recognize all types of stakeholders and understand their needs. The stakeholders' commitment, interest and power should be fully evaluated in order to assist project managers to solve the major problems in the stakeholder management process. Jergeas et al. (2000) propose that the aim of the project needs to be fully understood, and feedback from the involved stakeholders should be solicited to achieve alignment among the stakeholders and project team.

Several problems can be avoided if the stakeholders are effectively involved in the front end planning and engaged into the project team and a systematic approach is applied in order to manage and identify stakeholders in the project delivery process (Jergeas et al., 2000).

From the above statements, it can be argued that stakeholder management is significant in managing all activities of construction projects. Yang et al., (2009) characterise the importance of managing stakeholders in construction projects as follows:

- The construction projects are complex with many activities and multiple parties involved.
- The relationships amongst stakeholders in construction projects are temporary.
- Different stakeholders have different types and levels of interests and investments, so the project manager should communicate with all of them to satisfy their needs.
- All stakeholders should know their own tasks and roles under the project, and what are the requirements of the project.
- Poor implementation of stakeholder management can cause time delays and cost overruns in the project.

### ***3.5.3 Stakeholder management models in construction projects***

Several researchers have developed stakeholder management process models, which are illustrated in Table 3.3. However, it appears that there is no consensus on the most appropriate model. Cleland and Ireland (2002) propose some important strategies for the development of a project stakeholder management process. According to these researchers, a formal technique is required, because construction projects are subject to various changes for which informal approaches are inadequate. They further explain that effective stakeholder management should provide the project parties with decision-making intelligence. However, Chinyio and Akintoye (2008) argue that such a formalized model has not yet been fully developed. Karlsen (2002) emphasises that no formal and systematic stakeholder management process exists in real construction projects and that the stakeholder management is a random affair, due to the lack of routine functioning strategies, plans, methods or/and processes.

Cleland and Ireland (2002) propose some basic principles to develop the stakeholder management process. According to them a formal approach is needed, since projects are subject to changes for which informal methods are inadequate.

**Table 3.3 The stakeholder management process models****Source: Yang et al. (2010)**

Scholars	Stakeholder management process models
Karlsen (2002)	Identification of stakeholders; analysing the characteristics of stakeholders; communicating and sharing information with stakeholders; developing strategies, following up.
Elias et al. (2002)	Developing a stakeholder map of the project; preparing a chart of specific stakeholders; identifying the stakes of stakeholders; preparing a power versus stake grid; conducting a process level stakeholder analysis; conducting a transactional level stakeholder analysis; determining the stakeholder management capability of the R&D projects; analysing the dynamics of stakeholder interactions.
Young (2006)	Identifying stakeholders; gathering information about stakeholders; analysing the influence of stakeholders.
Bourne and Walker (2006)	Identifying stakeholders; prioritizing stakeholders; developing a stakeholder engagement strategy.
Olander (2006) adopted by Cleland (1999)	Identification of stakeholders; Gathering information on stakeholders; Identifying stakeholder mission; Determining stakeholder strengths and weaknesses; Identifying stakeholder strategy; Predicting stakeholder behavior; Implementing stakeholder management strategy.
Walker et al. (2008)	Identifying stakeholder; Prioritizing stakeholders; Visualizing stakeholders; Engaging stakeholders; Monitoring effectiveness of communication.
Jepsen and Eskerod (2009)	Identification of the (important) stakeholders; characterization of the stakeholders pointing out their (a) needed contributions, (b) expectations concerning rewards for contributions, (c) power in relation to the project; decision about which strategy to use to influence each stakeholder.

They also believe that successful stakeholder management should provide decision-making intelligence to the project teams. Although the scholars cited in Table 3 (which is adapted from Yang et al., (2010)) have developed several stakeholder management process models, it seems that these models are not coherent and detailed enough to be of practical use (Yang et al., 2010). For instance, the proposed model by Karlsen (2002) considers “*identification of stakeholders*” and “*analysing the stakeholders*” to be the first required stages to manage stakeholders; however he ignores the preceding stage of “*gathering information about stakeholders*”, which is considered imperative by Young (2006). Similarly, a comparative study conducted by Olander and Landin (2008) identifies five key issues in the stakeholder management process on construction projects that could come up with different project outcomes. The identified factors are: “*analysis of stakeholder concerns and needs; communication of benefits and negative impacts; evaluations of alternative solutions; project organization; and media*

*relations*”. Here, to Yang et al., (2010) it appears obvious that a formal stakeholder management process model should to be synthesized and developed.

In addition to the proposed processes for stakeholder management, Chinyio and Akintoye (2008) assert that in order to achieve the project objectives, it is also crucial to identify effective stakeholder management approaches. Yang et al., (2010) point out that, although a number of scholars have developed different approaches for stakeholder analysis (Newcombe, 2003; Bourne, 2005; Young, 2006), few scholars have made attempts to integrate practical approaches that can be applied for managing stakeholders (Reed et al., 2009). Among these were Chinyio and Akintoye (2008), who focused on stakeholder engagement approaches in the UK construction industry, and Reed et al. (2009) who focused on the approaches for stakeholder analysis applied in natural resource management research activities. The last two studies mentioned classified and proposed a series of approaches that have assisted the practitioners to better manage stakeholders. Nevertheless, the limitation of their scope indicates that they do not represent the complete picture of how to manage stakeholders effectively. Thus, it is required to expand their studies to integrate a series of practical approaches that can be applied to manage stakeholders.

It is claimed here that there is no model, as yet, of stakeholder management in the construction industry that focuses on design changes or considers them as an important variable to be included in the developed model. This deficiency in the existing models could lead to failure in managing design changes.

#### ***3.5.4 Findings on stakeholder management classification***

After comprehensively reviewing and analysing the literature in both areas, variation order management and stakeholder management in the construction industry, and developing a taxonomy for the variation order management literature earlier and also classifying the existing literature on stakeholder management, it can be clearly noted that little or no attention has been paid to the integration of stakeholder engagement and the variation order management systems. Integrating these would identify the responsibilities and authority of stakeholders and help them to understand the workflow of variation order management systems, to better manage variations. This deficiency in studying the linkage between these areas can be clearly seen, as after comprehensively reviewing the existing body of literature no single study was found that links them.



Additionally, the need to engage stakeholders in a variation order management system to better manage variation orders in the design stage will be examined later in the exploratory interviews.

### **3.6 Stakeholder engagement in managing variation orders**

The absence of a clear relationship between the engagement of stakeholders and their responsibilities in the existing variation order management practice and theory has led the researcher to further investigate how stakeholders are engaged in the existing variation order systems. In addition, the researcher will investigate how variation order management literature and current practice fail to capture the stakeholder engagement theory in order to better understand the deficiencies in the current practice. This investigation was based on three major factors, which are discussed in the next sections as follows:

- Stakeholder engagement in the existing variation order management systems
- Stakeholder engagement in the existing variation order process map
- Communication and co-operation among stakeholders in the existing methods for variation order management.

#### ***3.6.1 Stakeholder engagement in the existing variation order management systems***

Generally speaking, any organisation must engage with its stakeholders at all stages of the project. Stakeholders must be involved in any variation order management system process. Moreover, the engagement of key stakeholders throughout project activities is considered to be one of the critical factors of success for construction projects. Chess and Purcell (1999) emphasise that stakeholders should be engaged at early stages, and this is considered to be crucial for stakeholder analysis and decision-making. So far, several strategies have been acknowledged as useful in managing variation orders that are related to stakeholder management. As discussed above, Charoenngam *et al.* (2003) emphasise the importance of establishing communication and advise making good use of the Internet technology as the communication media. Chan and Yeong (1995) assert that good contract documentation, and efficient communication and cooperation between building team members are major elements that can facilitate the task of managing change orders.

Moreover, various systems have been developed by scholars to manage variation order in the construction industry. For instance, Ibbs *et al.* (2001) introduced change management system to overcome or minimize delays, cost overruns and general claims associated with project changes. Charoenngam *et al.* (2003) developed and utilized a web-based application for managing change orders in construction projects that supports documentation practice, communication and integration between different team members in the change order workflow. CIRIA (2001) published a guide to present best practice recommendations for the effective management of change on construction projects. Motawa (2004) presents a systematic approach to modelling change process in the construction industry, representing the key decisions required to implement changes. Arain (2008) presents a knowledge-based decision support system (KBDSS) for the management of variations. The KBDSS is able to assist project managers by providing accurate and timely information for decision-making.

These variation order management systems have been subject to much criticism on the basis that they lacked the basic principle and process of implementing controls for future variation orders in construction projects (Arain, 2008). Nevertheless, most of these systems have their pros and cons and the while one of them might be suitable to one project, it might not be practical enough for another. Yet, it is being claimed here that no system integrates the stakeholder mapping effectively during the process of variation order management, which can be a result of several reasons such as:

- The importance of stakeholder engagement has only been realized recently.
- Most of the developed systems in variation order management focus on IT-based or web-based methods.
- Variation order management systems focus on evaluating the variation effects on certain project elements.
- Causes of problems among stakeholders during variation order management process are not clear enough or not consider as a big issue.

Moreover, no system identifies the positions or authorities of stakeholders in the variation order management process to assist them to better manage variation orders and to overcome the potential obstacles. This issue of the lack of stakeholder engagement in the established models such as those of Charoenngam *et al.* (2003), Motawa (2004),

Ibbs *et al.* (2001) and Arain (2008) can be considered as a deficiency for managing variation orders effectively. As a result, employment some of these models can fail due to the absence of clear stakeholder engagement, which can negatively influence the progress of managing variation orders and lead to conflicts and disputes, as stakeholders must be involved in each single activity in the project.

### ***3.6.2 Stakeholder engagement in the existing variation order process map***

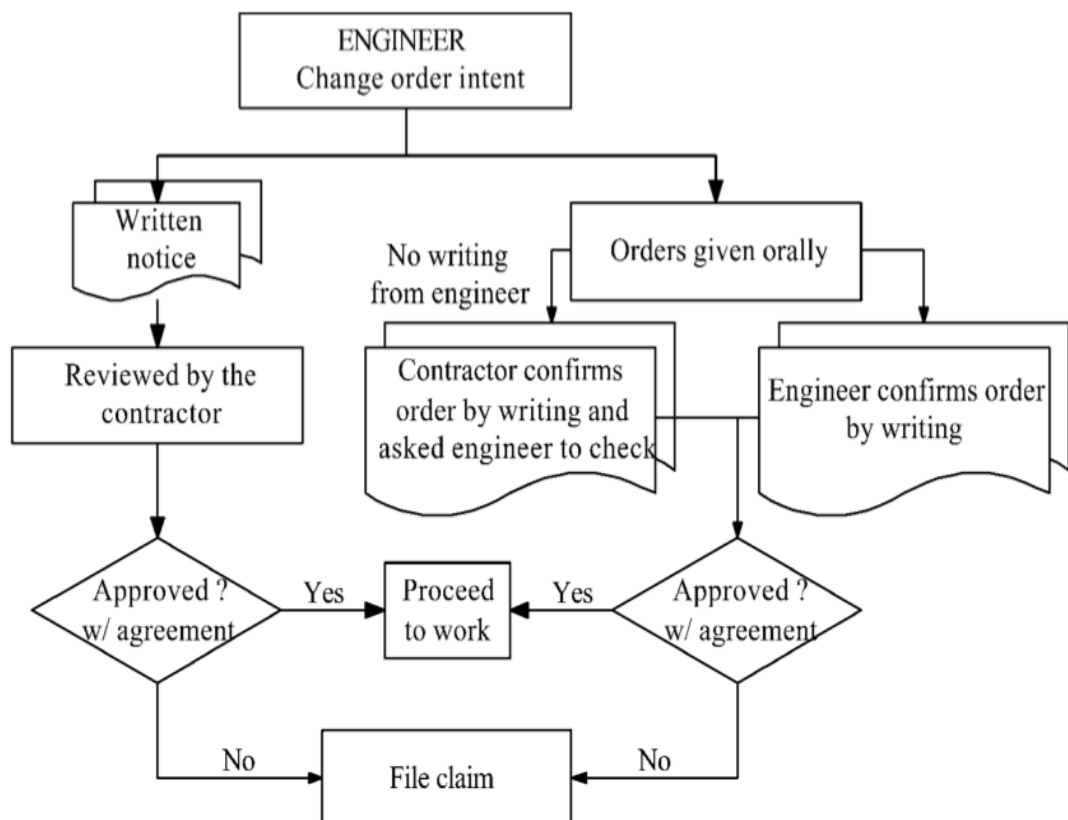
Both public client and design consultant can initiate a variation order, as they are the key stakeholders of the design stage. The request of a variation order has to be in written form; however in some cases an oral form is acceptable as well (Charoenngam *et al.*, 2003). According to Charoenngam *et al.*, (2003) an effective variation order management method can be developed by understanding the variation order process or workflow. In a study conducted by Alsuliman (2009) to investigate the impact of variation orders in the Saudi construction industry, two case studies were observed to address the process of obtaining a variation order. The study indicated the process of initiating a variation order takes a considerable amount of time before getting approval, due to the correspondence between the stakeholders involved in the project. The duration of the process cannot be estimated, as it depends on the size of the variation order. The variation order process can start from the client or/and the consultant. In the design phase, when the public client's organization initiates a variation order, it is necessary to follow a number of steps, which are:

1. The client representative asks the consultant for the variation orders in written form.
2. The consultant studies and analyses the variation order with the design team.
3. The consultant evaluates and estimates the cost and time of the variation; then recommends to the client whether the variation would improve the project or not.
4. The client representative and his team study the consultant's changes to the design before making the decision if the offer is approved or rejected.

If the consultant or someone who works under the consultant's authority, such as the architect, the quantity surveyor or services engineer, asks for a variation order, certain steps that have to be followed in order to obtain the variation. Usually, the consultant addresses the client about the variation order orally to get the preliminary approval.

After that, the consultant's organisation evaluates the need for the variation order and its impact on the project's lifecycle. The consultant then writes a letter to the client showing the variation order and its cost and time, to get the approval to implement it.

(Charoenngam *et al.*, 2003) cite the ICE (Institution of Civil Engineers) forms of contract to identify the practice of the variation order process, as these are well accepted standard forms. The ICE conditions state that it is the Engineer who can initiate variation orders which should be in written form, but can also be oral. For the case of oral form, the ICE states that the instruction of the variation order should be confirmed in written form soon as possible. In the case where the written form is not supplied by the Engineer, the Contractor can make a written form of the oral instruction of the variation order. According to the ICE conditions of contract, the variation orders may include, "*additions, omissions, substitutions, alterations, changes in quality, form, character, kind, position, dimension, level or line and changes in any specified sequence or method or timing of construction required by the contract*". Figure 3.3 represents a possible scenario for the process of initiating variation orders.



**Figure 3-3 The possible variation order process**  
Source: Charoenngam *et al.*, (2003)

Charoenngam *et al.*, (2003) developed a diagram for the change order process to speed up the process. In this diagram the client can write only through the architect/ engineer. The client uses correspondence to initiate variation orders or change of work. The main function of the client is to make a decision whether a variation order and its attached work will be approved or not. It must be noted here that the variation order must be fully evaluated in terms of its merits, cost and time by the architect/ engineer before getting the final approval from the client. The client will receive copies of correspondence for variation order request, cost proposal, variation approval and other reports made by the project parties.

The developed system assumes that the process of variation orders will be speeded up. It is assumed that the traditional process takes 12 days to facilitate the variation order, as a form must be filled manually and sent to another party. In this traditional method, a party needs two days to fill in the form and send it to the other party for each activity. However, by using the developed process, the duration of the process of obtaining the approval can be cut to six days. This is done by eliminating the usual extra day required in the case of each activity for delivery of the documents to the addressed construction participant.

Most of these processes for initiating variation orders have advantages and disadvantages and while one of them might be appropriate to one project, it may not be appropriate for another. In addition, most of these processes just identify the method of correspondence among stakeholders rather than identifying their responsibilities in the process of variation order management. It can be argued here that none of the mentioned processes explain the relationship between the involved stakeholders during the process of variation orders. Nor do these processes identify the responsibilities of the involved parties in terms of the power and interest for each stakeholder, in order to make their responsibilities and authorities clear to them and thus eliminate unneeded interactions, and avoid unexpected claims that might influence the workflow of the processes. Thus the processes developed so far for variation orders fail to capture the significance of stakeholder engagement that could improve the workflow of the variation order management process.

### ***3.6.3 Communication and co-operation among stakeholders in the existing methods for variation order management***

The complexity of variation orders needs to be managed effectively, otherwise disputes between stakeholders that relate to cost and time might occur. Variation orders are complex in nature, due to the involvement of the key stakeholders together with a lot of information that should be sent, checked, corrected, approved, requested, clarified, transmitted or submitted, among many other things (Charoenngam *et al.*, 2003). Meanwhile, effective communication among stakeholders is imperative to the success of any project in any organisation. A good communication process assists in maintaining good relationships between stakeholders and their organisations (Al-khafaji *et al.*, 2010). Chan and Yeong (1995) assert that high quality of contract documentation, and good communication and cooperation between the involved stakeholders can be used to manage variation orders efficiently. They explain that good documentation is generally facilitated by designing an efficient change order system, geared towards understanding the change order process or “*workflow*”, and can be collected from the standard forms of contract, while good communication, is facilitated by providing information using a well-timed procedure. Arain (2008) stresses the importance of communication and documentation in assisting the stakeholders to implement variation orders effectively. Arain and Pheng (2007) believe that proper communication will allow the project teams to ensure the timely implementation of the variation orders. Bakens *et al.* (2005) and Young (2006) emphasize that the key factor to good stakeholder management is effective communication. Landin (2000) believes that the good performance of any construction project and the ability to satisfy the stakeholders relies on the care taken and the decisions made by the decision makers in promotion of stakeholder communication.

Despite these views, it can be asserted that the issue of effective communication and cooperation among stakeholders during the process of the existing systems to manage variation orders effectively has not been explored much in the literature. This issue of the lack of clarification on the method of communication and cooperation among stakeholder can be considered as a shortcoming in managing variation orders effectively and makes the process of variation order management unnecessarily complex. Stakeholder engagement must result in valuable outcomes for those involved and must

be communicated in an appropriate approach. Hence, an effective method of communication among the involved parties is needed to better manage variation orders.

### **3.7 Implications of BIM in managing variation orders by stakeholders**

Recently, researchers have attempted to use BIM (Building Information Modelling) for a wide range of purposes, e.g., design and construction integration, project management, and facilities management, to improve the performance through the whole life cycle of construction projects (Azhar et al. 2008; Bazjanac 2008; Schlueter and Thesseling 2009). Basically, BIM simulates the construction project in a virtual environment. BIM can be viewed as a virtual process that involves all aspects, disciplines, and systems of a facility within a single, virtual model, allowing all design team members to collaborate more effectively than using traditional processes (Azhar, 2011).

One of the important issues that needs to be considered in this research area is the implications of managing in a BIM environment in relation to the engagement of stakeholders in the process of variation order management. BIM can assist the design team to efficiently implement variation orders and encourage the stakeholders to effectively collaborate during the process of the design stage. Carmona and Irwin (2007) claim that when the model is being created, team members can refine and adjust their proportions based on project specifications and design changes to ensure the model is as accurate as possible before the project physically breaks ground. Azhar et al., (2008) emphasise that BIM represents a new paradigm within the construction industry; it encourages integration of the roles of all stakeholders on a project. It has the potential to promote greater efficiency and harmony among stakeholders.

The proposed model in this research will not take the BIM environment into consideration, as it aims to identify the method of the relationship and communication among the involved stakeholders with regards to their level of power and interest in managing variation orders rather than simulating the implementation of variation orders in a virtual environment. However, this issue can be considered in future research.

### **3.8 Stakeholders in the Saudi construction industry**

In the context of this research, the participants at the design stage in Saudi public construction projects can be divided into two main stakeholders, namely the public

client and design consultant. According to Bresnen et al. (1990) the term “client”, refers to the financial sponsoring organisation directly responsible for the production and development of a project. In the Saudi construction industry, the government is the major client, accounting for approximately 67% of the nation's construction industry volume (Alsager, 2001). The public sector clients are the Saudi Ministries that have construction management departments. The respondents representing the public clients will be project managers and/or client representatives for building construction projects. The clients, public sector bodies in Saudi Arabia, can be considered as stakeholders in other ways, as they obviously affect individuals and organisations through their regulatory policies and authorities.

In contrast, the design consultants are an important party in construction projects and responsible for delivering design quality that seeks the best potential satisfaction of clients' requirements and expectations (Almazayad, 2009). In Saudi Arabia, there are two different forms of recognition for design consultants. Firstly, recognition by the Ministry of Municipal and Rural Affairs and the Saudi Council of Engineers which enables the design consultant to be invited or/and recommended by public sector departments to design their projects. Additionally, these design consultants are eligible to private and different kinds of construction projects. The second type of design consultants are those only recognised by the Saudi Council of engineers. These design consultants are only eligible to design private construction projects (MOMRA, 2011; SCE, 2013). The design consultants in this study will be only the consulting engineering firms certified by the Ministry of Municipal and Rural Affairs in Saudi Arabia.

### **3.9 Engagement of stakeholders in Saudi current practice**

The previous sections in this chapter mostly covered the literature in relation to stakeholder management in the construction industry and highlighted the shortcomings in the existing variation order management systems that fail to capture the importance of stakeholder engagement. As this study was set to take place in the Saudi construction industry, it was imperative to review and clearly understand the current practice of variation order management in relation to stakeholder engagement. This final section of the review is based on the literature on variation order management and stakeholder management in Saudi Arabia and aims to help to shape the subsequent development of the main data collection stage.



The poor engagement and interaction of the involved stakeholders has led to the failure of any variation order management system in the Saudi construction industry. Arain *et al.* (2006) explain that the inconsistencies between design and construction have a negative impact on the performance of construction projects in Saudi Arabia and identify a number of factors that are responsible. These include: (a) the involvement of the designer as a consultant, (b) communication gaps occurring between the contractor and the designer, (c) insufficient details in the work drawings and (d) lack of coordination between the parties. The process of variation order management needs the stakeholders to be engaged in each step to help the project team to manage the variation order effectively. In fact, the stakeholders' responsibilities in the variation order management process are not clear and identified. For instance, awareness of who has high/low power or interest, the client or/and the consultant, is needed to evaluate the variation order.

Bubshait and Al-Musaid (1992) carried out a survey to measure the level of involvement of public clients in the three main phases of the construction process in Saudi Arabia, namely planning phase, design phase, and construction phase. The results of the survey indicate public clients are more frequently involved in the construction phase than in the planning and design phases, with the least involvement in the design phase. The low level of public client involvement in design is due to the nature of the public construction projects in Saudi Arabia, where public clients do not periodically review the progress of design professionals, but rather carry out the final approval. According to the study, public sector bodies usually have the facility and ability to involve themselves more in the construction phase, notably in project supervision, and in monitoring time, cost, and quality.

Lack of understanding of stakeholder engagement during the variation order management process affects the progress of the design and leads to many problems such as delay, cost overruns, design errors and conflicts among the stakeholders. Therefore, there is a concern about the poor stakeholder engagement in the current variation order management process. In fact, better understanding of stakeholder engagement during the change process would enable the design team and the public client to better manage the variation order, improve the design workflow and it would assist to have an agreed decision making process.

### **3.10 Summary**

This chapter has reviewed existing literature specific to stakeholder management in the construction industry and highlighted the existing relationship between the stakeholder engagement and the process of variation order management. It has found deficiencies in the engagement of stakeholders in practices of variation order management. Further, in this chapter the existing body of literature on stakeholder management has been classified into three main categories in order to investigate the degree of attention paid to the stakeholder management approaches, needs and models within the existing variation order management practice and theory. This review brought to light the shortcomings in both theory and practice of the existing variation order management process with regards to stakeholder engagement.

The chapter highlighted the importance of having a better understanding of stakeholder engagement during the change process in the Saudi construction industry to manage variation orders effectively. This chapter concluded by addressing the implications of BIM environment to the management of variation orders by stakeholders. From the literature review chapters (Chapters Two and Three), the researcher can argue that there is a clear lack of acknowledgement of the significance of stakeholder engagement in the process of variation order management systems. Additionally, no model in the construction research identifies the responsibilities and tasks of the involved stakeholders in each single stage of any model. These shortfalls have guided the researcher to conduct several fieldtrips to contribute to the development of the proposed model. The following chapters will investigate the current practice of variation order management in the Saudi construction industry and the responsibilities of the different stakeholders in managing variation orders. Subsequently, the appropriate level of stakeholder engagement to improve the management of variation orders will be determined.

## **Chapter 4 Research methodology**

### **4.1 Introduction**

This chapter presents the theoretical positioning of the research relating to better management of variation orders. It synthesises the findings of the previous chapters to assist in the subsequent development of the research. Additionally, this chapter establishes research philosophies, approaches and paradigms, to determine research methodologies and suitable methods to collect and analyse the required data. The researcher also presents the modelling techniques in construction research, discusses the need for a model to fulfil the study aim and objectives and explains the design and development of the proposed model.

### **4.2 Research Philosophies and Approaches**

The process of carrying out a research project of any kind has a well-known structure that generally includes a beginning, middle and an end. However, in order to be able to produce such a structure with an acceptable level of consistency, it should align with certain research philosophies and approaches. One fundamental prerequisite for a researcher in the area of management is the need to understand (at a theoretical level) and create (at the practical level) a philosophical stance towards the topic he/she is investigating. In this respect, Crowther and Lancaster (2009) explain that an understanding of the major philosophical orientations to research practice within the discipline in general is necessary and a grasp of the numerous approaches to theory development in a research process is vital. The research process, explains Creswell (2003), involves a research paradigm underpinned by philosophical postulations and general approaches, in addition to the particular procedures used. A researcher engages in a research project based on a need or a research interest and therefore the question of ‘what to research?’ is pretty much answered. That might not apply to the ‘how to research?’ question, as this necessitates an understanding of a wide range of research philosophies. Here, Saunders *et al.* (2009) indicate that a research philosophy is linked to the nature of knowledge formed by ‘the researcher’s predilections and biases’ that influence how he/she actually sees the world and this leads to the selection of a certain strategy/strategies and/or a method/methods. Following the same line of thought, Guba and Lincoln (1994) state:

*“Both qualitative and quantitative methods may be used appropriately with any research paradigm. Questions of methods are secondary to questions of paradigm, which we define as the best basic belief system or world view that guides the investigation, not only in choices of method but in ontologically fundamental ways.”(Guba and Lincoln, 1994, p105)*

Hence, the claim that research methods should be selected in parallel, with reflection on the ontological and epistemological stances that the researcher holds, is supported by various scholars (e.g. Dainty, 2008). This combination of forms can be described as empirical research. Empiricism is appropriate in the present case, since the study is building a theory based on the current practice of variation order management and the experience of the participants in the study.

This section will therefore address some philosophical underpinnings that influence the current research work.

### **4.3 Research Paradigms**

During the last few decades, different research paradigms have emerged in social science research at large. This is attributed to the significant development in social science research. According to the Webster Dictionary, a paradigm is *‘an example or pattern: small, self-contained, simplified examples that we use to illustrate procedures, processes, and theoretical points’*. A highly cited definition of a paradigm is that by Thomas Kuhn (1970) in which the term is described as a concept in The Nature of Science Revolution, i.e. the paradigm comprises the underlying assumptions and intellectual structure upon which research and development in a field of inquiry is based. More recent definitions were drawn up by Patton (1990) and Guba (1990) where the former describes paradigm as *‘a world view, a general perspective, a way of breaking down the complexity of the real world’* and the latter sees the concept as *‘a set of beliefs and feelings about the world and how it should be understood and studied’*. A similar, though more concise, explanation is given by Kinash (2014) who describes it as *‘a matrix of beliefs and perceptions’*.

Apart from the question of ‘what is paradigm?’, a similar debate in the literature revolves around the question of ‘why do we need it?’ In this respect, scholars (e.g.

Babbie, 2009; Maxwell, 2005; Mertens, 2009 and others) suggest that a paradigm acts as the ‘logical framework’ which makes the creation of theories possible. So, positioning one’s research within a well-established paradigm makes that piece of research meaningful, i.e., as Maxwell (2005) explain, that philosophical assumptions describe the nature of the world (ontology) and the way the author understands it (epistemology) and probably, but not necessarily, how other academics understand it.

In addition, the selection of specific methodological strategies within a piece of research aligns with whatever paradigm a researcher would position his/her research in. Guba and Lincoln (1994) suggested that when researchers assume certain research paradigms, they provide answers to the following issues:

- a) the *ontological* issue which is associated with the form and nature of reality,
- b) the *epistemological* issue which is related to the researcher’s perception about knowledge, and
- c) the *methodological* issue which is relevant to how a researcher figures out what can be known.

In the remaining part of this section, the researcher discusses such issues in more detail alongside other implied concepts.

#### **4.3.1 *Ontological Orientation***

According to the Merriam-Webster Dictionary, the term ontology is ‘a branch of metaphysics concerned with the nature and relations of being’. In other words, ontology is concerned with the question of what is real. To Crowther and Lancaster (2009) and Bryman and Bell (2007), this approach is based on suggestions about the ‘nature of phenomena or the ‘nature of social entities’. Furthermore, Bryman and Bell (2007) state that an ontological position is formed by considering the way that research problems are considered. However, Kamil (2011) pinpoints objectivism and subjectivism as ‘the two extremes that characterize the ontological and epistemological viewpoints’. The objectivist view considers the scrutiny of research problems. The subjectivist view mulls over investigating research problems, involving the perception that they represent constructions formulated by the perceptions and performances of social actors.

This study concerns the development of a better variation order management model that covers both objective and subjective processes. The proposed model should include quantitative and qualitative methods to solve the research problem. The qualitative method seeks to clearly understand and investigate the current practice of variation order management in the Saudi public construction projects. The quantitative method intends to determine the level of power of held by the involved stakeholders and the level of interest that they show in improving the current practice. The qualitative method is then used again, to test the developed model in terms of its applicability, effectiveness and clarity.

To reach to the research aim, this study must provide a structured method of determining the level of power and interest for public clients and design consultants that will allow them to manage variation orders in the design stage effectively. The integrated model of variation order management, from the researcher's point of view, represents a set of requirements and actions to be conducted to ensure the applicability, effectiveness and clarity of the model. Furthermore, the model determines the level of the stakeholder engagement and positions, and consequently, the success of the model in achieving its goals. In light of the above, to develop an integrated system to manage variation orders that exists as a phenomenon outside the people who might use it, the researcher should adopt an *objectivist* position regarding this particular phenomenon.

On the other hand, the researcher considers that the variation order management in the design stage is a developed form of "reality" that emerges from the perceptions of stakeholders who have been or might be engaged in the future in managing variation orders in the design stage process, and which concerns the success of such projects.

The proposed model should include quantitative and qualitative methods to solve the research problem. Consequently, the current practice of variation order management in the Saudi construction industry was investigated through the stakeholders who are involved in managing variation orders. Therefore, the developed variation order management model cannot be considered as an external reality. The model development involves active participation of public clients and design consultants in constructing this social phenomenon. As a result of that, the researcher has a *subjectivist* view of this reality.

On the basis of the above description, the researcher has mixed ontological views represented by the *objectivist* and *subjectivist* views. Consequently, the researcher found that employing mixed ontological views would be appropriate to achieve the research aim and solve the problems. These mixed ontological views would assist the researcher to investigate the current practice, engage the stakeholder effectively and test the outcomes of the study. These two philosophical positions will be adopted to develop an effective variation order management model for the design stage.

#### **4.3.2 Epistemological Orientation**

One of the most interesting comments on epistemology was written by Phil Johnson and Joanne Duberley (2000) in their book 'Understanding Management Research'. To these authors, 'although scientists and philosophers have debated epistemological questions since the time of Plato and Aristotle, the term 'epistemology' remains somewhat esoteric for most people and usually it obfuscates more than it reveals'. Further down in the chapter, the authors explain that the term developed from two the Greek words: 'episteme' which means 'knowledge' or 'science'; and 'logos' which means 'knowledge', 'information', 'theory' or 'account'. A simpler way to look at the term is actually documented in many research methodology resources in which epistemology is often referred to as an examination of the nature of knowledge or as a concept addressing the questions of '*how do we know?, how is knowledge derived?, how is it to be validated and tested?*' and '*what are the limits of our understanding?*' According to Coyle (2007, p11), epistemology is a philosophical position related to knowledge theory that attempts to discover how we can know what we know.

Regarding management research, Sulkowski (2010), for example, argues for what he calls 'dualistic vision of management epistemology' in which he looks at the concept from two angles. The first angle is the 'objective' and the second one is the 'relativist', which he describes as 'very simplified, stereotypical and inadequate in relation to the development of contemporary management', but 'contrary to this reservation, this elementary division is a basic cognitive category accepted by specialists in management'. In fact, an epistemological direction is an aspect linked to obtaining an answer to what can be considered in academia as acceptable knowledge (Saunders et al., 2009, p112). Such aspects shed light on the manner a researcher tackles any given social phenomenon in answering his/her research questions.

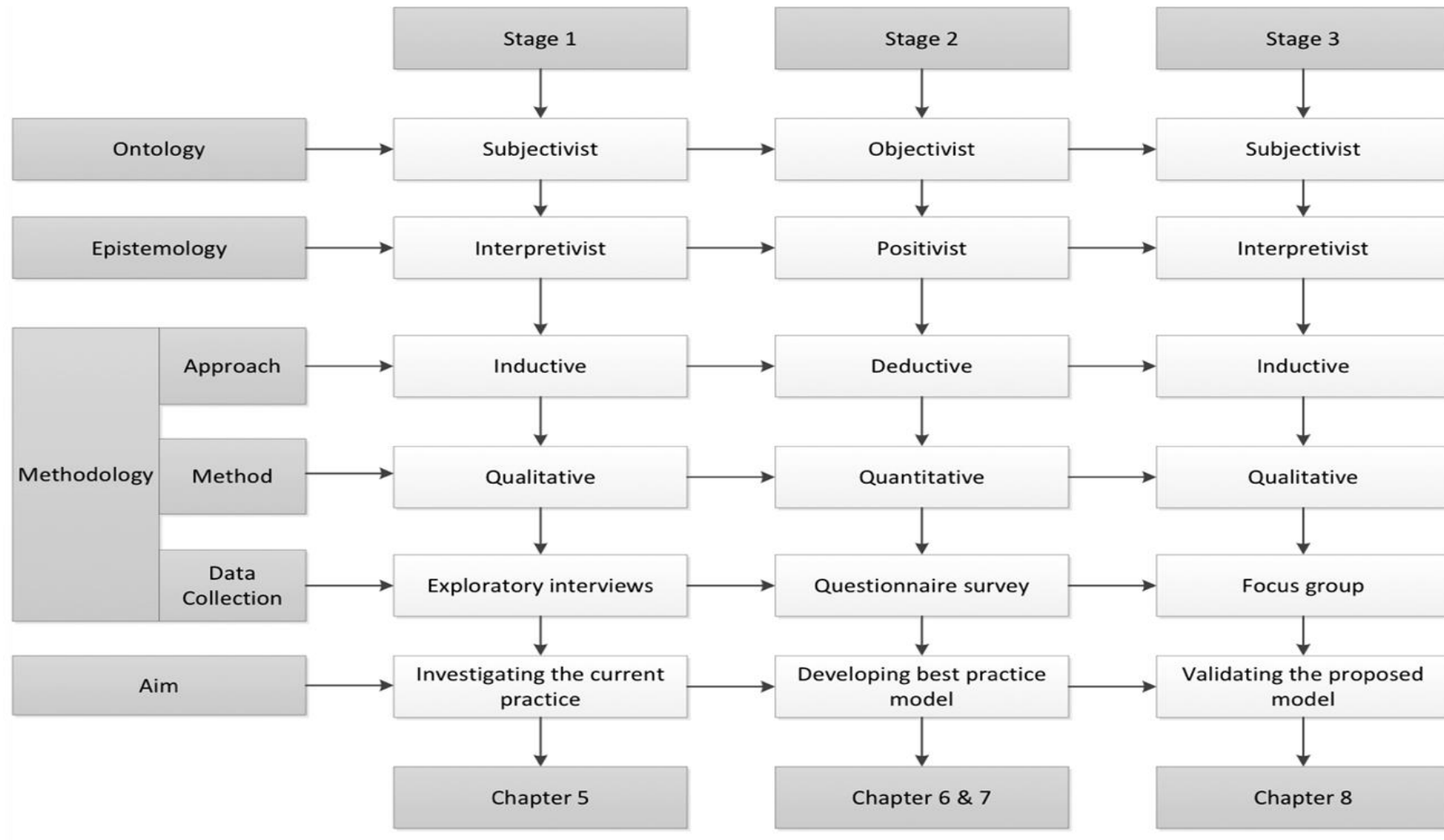
Moreover, scholars might investigate a certain social incident by adopting the philosophy and measures of the natural sciences (Bryman and Bell, 2007, p16), expressing what is called ‘a *positivist*’ vision. The concept of positivism is that it is possible to measure human behaviour in *objective* and *scientific* methodologies, in a very similar way an object is dealt with in the natural sciences. Positivists believe that the world is managed by instinctive law/s that control the way objects behave (McNeill and Chapman, 2005). On the other hand, researchers may take an opposite stance in which they view a dissimilarity between the way humans behave and the logic of the natural sciences, in the sense that social experiences and incidents are scrutinized on the basis of the way human beings make sense of their immediate world (Bryman and Bell, 2007, p16). This philosophical position is referred to as *interpretivism*. Such a concept is based on considering the diversity of human beings, who have the capability to reflect, make decisions and behave deliberately and individually when dealing with a specific social situation (McNeill and Chapman, 2005). Interpretivism, therefore, is based on a) phenomenology and b) symbolic interactionism, where phenomenology looks at how human beings make sense of their immediate world and interactionism aligns with the continuous elucidation of the action of fellow humans, when involved with them. This process causes us to adjust our thoughts and consequential behaviour (Saunders *et al.*, 2009). To sum up, Saunders *et al.* (2009) emphasise the need to be familiar with such discrepancies between individuals in order to develop knowledge.

The research aim and objectives necessitated understanding the current practice of variation order management in the Saudi public construction projects. Therefore, the researcher considered that following the interpretivist view was appropriate to this research because utilising this approach for acquiring knowledge enriched the study by gaining the opinion of public clients and consulting firms on what are the associated problems with the current practice and how are they engaged currently.

Furthermore, this research takes into consideration that the development of the variation order management model needs to identify the level of stakeholder engagement and their positions in each stage. Dealing with this challenge requires obtaining tangible levels that quantify the intangible aspects of model success. This will facilitate benchmarking to compare the current practice against the best practice by combining their causes and effects. Hence, the positivist paradigm, in the opinion of the researcher, was considered an appropriate approach to be employed in this situation.



Following the same line of thought, using both an interpretivist and positivist philosophical stance to address the current research problem and to answer the research questions, in the present study a pragmatist epistemological point of reference is adopted. Figure 4.1 below illustrates the elements of the paradigm adopted.



**Figure 4-1 The pragmatist paradigm adopted**

The study was divided into three sequential stages to achieve the research aim. In the first stage, a subjectivist research ontology was adopted in the form of an interpretivist research epistemology, by applying an inductive approach with a series of exploratory interviews to investigate the current practice of variation order management and build a conceptual model for it. In the second stage, the researcher adopted an objectivist research ontology, in the form of a positivist view, by using a deductive approach to verify and confirm the formulated research propositions and develop a best practice model by conducting questionnaire survey. In the third stage of this research, a subjectivist research ontology was employed, again in the form of the interpretivist view, with an inductive approach to validate and test the developed model by carrying out a focus group exercise.

#### **4.4 Research Methodology**

A preliminary dictionary search of the term ‘methodology’ defines the term as “*a system of ways of doing*” (Cambridge Dictionary). Although this definition might seem too general to some or simplistic to others, it is actually meaningful. To Saunders *et al.* (2009, p3), research methodology consists of the theoretical frameworks of how to conduct a research study. Putting it in another way, methodology is about the way through which researchers enable their research to reach what can be considered by other academics as ‘acceptable knowledge’. Yet, it is worth mentioning that the literature often refers to two approaches that, if used properly by a researcher, can enable either *testing* a theory or *building* a theory. These are the deductive approach and inductive approach. These approaches are explained in the following paragraphs.

##### **4.4.1 Inductive Research**

As an adjective, most English dictionaries would identify the word ‘inductive’ as using any set of facts or concepts to reach a general principle. In terms of research in the social sciences, inductive research allows the researcher to scrutinize the experimental context in order to build one hypothesis or more and then contribute to theories. This is done based on the processes involved in data collection and analysis. Gill and Johnson (2010, p 56) explain that the process of observation therefore, as seen by Crowther and Lancaster (2009, p 31) is the departure point through which description of the social phenomenon being studied is possible and is required to provide explanation. Such

explanations, add Crowther and Lancaster (2009, p 31), are typically built up in the form of frameworks, hypotheses or theories.

This model of reasoning informed the literature review in the first phase of this study. It was followed to collect information and data about the current practice of variation order management and its strengths and weaknesses. The data collected were synthesised and employed to design a conceptual model for the current practice in the design stage. The conceptual model, resulting from the literature review and exploratory interviews, was then discussed in the research propositions to design a questionnaire to gain more data and insights to develop the best practice. This approach was also implemented in the third phase of the study, to validate the developed best practice using the focus group workshop.

#### ***4.4.2 Deductive Research***

The word ‘deductive’ is also an adjective and, as compared to the word inductive’, often refers to the process of reaching a conclusion by forming an opinion based on careful thinking about some given/known facts. It is therefore referred to by Ghauri and Gronhaug (2010) as a state in research reached through ‘logical reasoning’. It is worth mentioning, however, that the state or conclusion reached through logical reasoning is not necessarily true by default: the action of deductive reasoning does not guarantee reality or truth in the real world, but only has to make logical sense. These two authors add that researchers who adopts a deductive research approach often build theories or hypotheses prior to empirically examining such theories or hypotheses to decide on their validity (Crowther and Lancaster, 2009). In other words, a concept or theory is formulated and then the propositions of the resulting theory are examined in a later stage (Gill and Johnson, 2010, p28). It is noteworthy to mention here that the foundation of the researcher’s theoretical framework is not as important as the reasoning behind the method of building the theoretical construction and the manner in which it is examined during the exposure of that conceptual theory to experimental questioning (Gill and Johnson, 2010). This deductive approach is characteristically connected to philosophical postulations linked to the ‘positivist’ paradigm (Gill and Johnson, 2010).

In the search for a distinction between the two approaches, it is assumed that that the deductive approach is a model to follow if the study subject involved has been

comprehensively researched and a conceptual framework hypothesis can be reached from the wealth of literature on the topic (Saunders *et al.*, 2009, p 127). However, if the research study revolves around a subject that is surveying a newly studied topic with limited literature, the alternative position for the researcher is to adopt an inductive approach, so that data can be elicited and analysed and at this stage conceptual hypotheses are proposed (Saunders *et al.*, 2009, p 127). In line with this, Gill and Johnson (2010, p56) explain that the outcome of an inductive approach is a theory, which can be described as *grounded in observation*.

The deductive approach was implemented in the second phase of this research to develop the best practice model of variation order management from those identified by the inductive approach in the first phase of the study. In addition, this approach was used to verify and confirm the formulated propositions.

#### **4.5 Research Methods**

According to Silverman, (2004, p 306), a research method is ‘the choices the researcher makes about cases to study and methods to be used for data collection and data analysis planning as well as carrying out the research study’. It also includes methods, techniques and procedures used in the process of putting into operation the research proposal, and ‘the underlying principles and assumptions that underlie their use’ (Babbie and Mouton, 2002: p.647). Dainty (2008) carried out a study in which the researcher examined the research methods employed by construction management researchers and discovered that quantitative, qualitative and mixed methods are commonly used approaches. In the current research a mixed methods approach is used.

##### **4.5.1 Qualitative Methods**

A qualitative approach is generally linked to inductive research, as a bottom-up approach in which new hypotheses and theory are generated from data collected. So, in this approach the researcher assumes the constructivist perspective to knowledge (Creswell, 2003). However, the qualitative approach is another methodological approach that is ‘subjective’ in nature (Naoum, 2007). Fellows and Liu (2008) explain that in this approach the research topic is examined in an attempt to boost understanding of the topic and to elicit interrelated data to generate/modify theories. Qualitative methods, try to recognize the basis for things that happen by looking at the meaning and

the connotation to individual characteristic to social phenomena (Fellows and Liu, 2008, p 9). Qualitative research might involve a vast number of research techniques.

The current study used exploratory interviews to investigate and evaluate the current practice of variation order management in the Saudi construction industry and to build a conceptual model for it. In addition, the qualitative method seeks to determine the strengths and weaknesses in the existing condition of variation order management. The method employed is described further in the following chapter. Moreover, the study employed another qualitative method in the last stage of this research, which is the focus group technique. This technique of data collection was intended to validate the developed model, as will be explained later in section (4.5.3) in this chapter.

#### ***4.5.2 Quantitative Methods***

Quantitative research is generally associated with deductive research, which is a top-down approach in which the hypothesis and theory would be examined by data. In this approach, researchers principally adopt a positivist perspective of knowledge development (Creswell, 2003). So, according to Noam (1998) this is a methodological approach that is 'objective' in nature. Consequently, researchers who pursue quantitative approaches are likely to apply 'scientific methods', so that their research results in specific findings, in addition to propositions and hypotheses (Fellows and Liu, 2008).

The quantitative element in this study comprised a questionnaire survey used to develop the best practice model of variation order management and to verify and confirm the formulated propositions. Additionally, the method will assist the researcher to achieve objectives 3, 4 and 5 of the study. This technique will be discussed in depth in Chapter Six.

#### ***4.5.3 Focus Group Workshop***

Gibbs (1997) describes focus group research as involving 'organized discussion with a selected group of individuals to gain information about their views and experiences of a topic'. Similarly, Greenbaum (2000) characterized the focus group as a qualitative technique employed to elicit data through a group of people drawn together in one location to tackle some questions that are of great concern to the researcher. According

to Gibbs (1997), the benefits of focus group research include gaining insights into individuals' collective understandings of everyday life and the methods by which such individuals might be prejudiced by the opinions of others in a group situation. Krueger (2009) therefore explains that the use of this research technique can provide insights, ideas and concepts, in an investigative style, to reach a consensus about a matter that is grasped in a different way. It can also uncover particular aspects distinguishing a problematic case and bring together further information that can be used to support other research methods (Krueger, 2009). This research carried out two focus group workshops with experts in Saudi public construction projects to confirm the applicability, effectiveness and clarity of the developed model. This technique will be explained comprehensively in Chapter Eight.

#### **4.6 Research ethics**

According to Israel and Hay (2006) to behave ethically means *"to protect others, minimise harm and increase the sum of good in the world"*. The Economic and Social Research Council (ESRC) (2010) defines research ethics as *"the moral principles guiding research, from its inception through to completion and publication of results and beyond"*. The ESRC (2005) affirms that *"almost without exception, social science research in the UK has been carried out to high ethical standards"*. Similarly, Hammersley (2009) argues that it would be extremely rare for social researchers to behave unethically.

Heriot-Watt University has established the University Ethics Committee to guide schools, monitor procedures and ensure appropriate ethical issues are being considered. The committee has asked schools to submit ethical approval procedures relevant to their research activities (HWU, 2010). Therefore, the researcher was asked by the School of the Built Environment to submit the protocol for the ethics approval form before conducting each type of fieldwork.

The researcher was fully aware of the school procedures and assured all participants in each survey that *"this study has been reviewed and received ethics clearances through the office of research ethics at Heriot-Watt University"*. Although no consent forms were required for the surveys, the participants were informed that *"the data collected will be kept confidential and no firm, organisation or individual will be identified in the thesis or in any report or publication based on this research"*. Prior to answering each

survey, the researcher told the participants that *“a copy of the summary report will be made available if required”*. Some participants required that, and the researcher will provide these later on. Additionally, the researcher asked the participants for permission to record the telephone calls in the exploratory interviews, also asked participants in the focus group sessions for permission to take some photos. However, one participant in session 2 of the focus group workshop refused to be photographed; the researcher respected the autonomy of the participant and no photos were taken of him.

#### **4.7 Modelling in construction research**

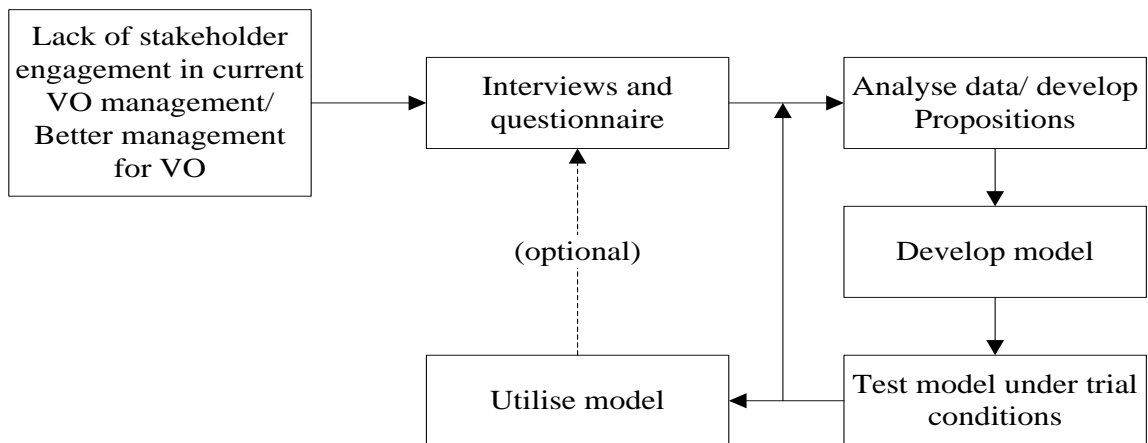
Modelling techniques have been applied in construction research since the 1960s to investigate and visualise the production process of the construction industry and its performance (Akinsola, 1997). According to Fellows and Liu (2008) *“Modelling is the process of constructing a model, a representation of a designed or actual object, process or system, a representation of reality”*. A basic definition of a model by Seeley (1996) states that *“a model is a procedure developed to reflect, by means of derived processes, adequately acceptable output for an established series of input data”*. The input data in the proposed model for this study consist of any variation order that occurs during the process of the design stage and the expected outputs would be better management of variation orders by speeding up the process and avoiding conflicts and disputes among stakeholders.

Ideally a model should be as simple as possible, to be manipulated and understood by people who use it, representative enough in the total range of implication and sufficiently complex to accurately represent the system of the model. Any model must attempt to fulfil these three seemingly incompatible criteria (Seeley, 1996). Here, this research attempts to fulfil the three criteria in the developed model as to be simple as possible to be understood by stakeholders, representative of all the potential variation orders in the design stage and complex enough to manage variation order effectively. Fellows and Liu (2008) assert that a model must represent and capture the reality being modelled as closely as is practical, and also a model must include the imperative characteristics of the reality, with regards to the rationale of designing the model, while being reasonably cheap to design, operate and easy to implement. The developed model would capture the reality of stakeholder engagement in current variation order management systems explicitly. In practice stakeholders work together to manage



variation orders; however no systems yet identify the stakeholders' responsibilities in terms of power and interest, which the developed model aims to do.

Models are considered as a benefit in that a model can help in explaining and predicting the behaviour of a real life situation. The prediction may have different levels of confidence, as the model aims to assist and inform the decision makers about the impacts of making a particular decision (Jaggar *et al.*, 2002). The most common stages in the development of a model, as proposed by Seeley (1996), are to state problem/objectives, obtain and collect data, analyse data/develop hypothesis, develop model, test model and utilise the model. The development stages of the proposed model, adapted from Seeley (1996), are shown in Figure 4.2 below:



**Figure 4-2 The development stages for a model**  
Source: Seeley (1996)

To Jaggar *et al.* (2002) the purpose of models can be summarized as assisting to provide data about the system of construction projects they represent, as follows:

- *“The communication of facts about the system.*
- *The communication of ideas about the system.*
- *The prediction of how the system will behave in certain circumstances.*
- *The provision of insight into why the system behaves as it does”.*

#### **4.7.1 Classification of models**

Various classifications of models have been given in the literature. Fellows and Liu (2008) cite Rosenblueth and Wiener (1945), who categorise models in science as:

- *“material models: transformations of original physical object,*
- *formal models: logical, symbolic assertions of situations, the assertions representing the structural properties of the original, factual system”.*

Subcategories, which may be considered as alternative categories, are as follows:

- *“open-box model: predictive models for which, given all inputs, the outputs may be determined,*
- *closed-box model: investigative models, designed to develop understanding of the actual system’s output under different input conditions”.*

The model in this study can be considered as formal model, as it is based on an established model and representing the factual improvements that can be added to current practice to better manage variation orders. Moreover, the developed model can be described as a closed-box model as it is designed for a clear understanding of the current practice process.

Following a similar line of thought, Fellows and Liu (2008) further cite a model categorisation suggested by Churchman *et al.* (1957) as follows:

- *“iconic: visual or pictorial representation of certain aspects of a real system,*
- *analogue: employs one set of properties to represent some other set of properties which the system processes,*
- *symbolic: requires logical or mathematical operations”.*

Sayre and Crosson (1963) propose a similar model classification, which is also cited in Fellows and Liu (2008) as:

- *“replications: display significant physical similarity to the reality, such as a doll,*
- *formalisations: symbolic models in which more of the physical characteristics of the reality are reproduced in the model, symbols are manipulated by techniques of a well-founded discipline such as mathematics,*

- *simulations: a formalisation model but without entire manipulation of the model by the discipline's techniques in order to yield an analytic solution or a numerical value".*

Although the more common types of models for general research purposes are analogue and symbolic, iconic models and replications are more usual in construction research (Fellow and Liu, 2008).

#### **4.8 Need for a model**

Based on the findings revealed from the previous stages of this research, it was noted that there is a clear absence of effective stakeholder engagement in the existing variation order management systems. Logically, any variation order management system involves stakeholders to deal with it, however there is a need for a model that identifies the stakeholders' responsibilities in terms of the level of power and interest, explicitly to manage variation orders effectively. In addition to that, a comprehensive investigation was carried out to ensure that no system implicitly integrates stakeholder engagement by explicitly identifying their responsibilities, authorities and positions during the process of variation order management. It was found that this deficiency in stakeholder engagement has led to poor management of variation orders, particularly in Saudi public construction projects.

Hence, this research makes an attempt to fill this gap in construction industry research by developing a model that integrates the most common stakeholder mapping, which is the power-interest matrix, with the basic principles of any variation order management system, which can be basically described as *identify variation, analyse variation, evaluate variation, implementation and documentation*. Additionally, these basic principles are applied to the Saudi current practice of variation order management. This integration of different two concepts in the construction industry would lead to better management of variation orders and improve the workflow of the variation order management process. Additionally, the proposed model could help the design parties to overcome disputes and conflicts by classifying stakeholders with regards to the power they hold and the level to which they are likely to show interest in supporting or opposing each step in the developed model.

## **4.9 Model development**

Several different modelling techniques exist in the construction industry; each of these existing models has a range of different applications, so it is imperative to choose the correct type of model in order to achieve the best possible outcomes (Fowkes and Mahony, 1994).

In this research, the methods applied to develop a model to better manage variation orders involved analysing the data from the existing body of literature review and empirical data collection, including the exploratory interviews and the questionnaire. The data collection from the qualitative and quantitative methods was designed specifically in order to collect the information required for the model development. A representative sample of public clients and consulting firms was adopted to ensure the model would be applicable to them in the design stage. The development of the model went through two stages which were (a) design an initial model based on the findings of the questionnaire study, and (b) design the final model after testing of the initial model by experts in Saudi construction industry.

### ***4.9.1 Aim and objectives of the model***

The aim of this section of the research is to develop a model which could better manage variation order at the design stage in Saudi public construction projects. The model is also required to measure the power-interest level for both public clients and consulting firms to identify their responsibilities and communication method in relation to the level of power and interest to improve the workflow of managing variation orders and avoid conflicts and disputes among stakeholders. The steps for achieving the model are as follows:

- Collecting and analysing data from interviews and questionnaires.
- Locating the involved stakeholders into the power-interest matrix.
- Classifying stakeholders in relation to the power they hold and the level of interest they show.
- Establishing the format of the model.
- Designing and building the model.
- Testing the model by conducting focus group sessions with experts.

#### **4.9.2 Design of the model**

Designing the proposed model involved going through comprehensive studies and analysis before reaching the proposed version. This model is based on two main stages that have led to the design of the proposed model, namely the current approach and proposed approach, each consisting of the following sub-stages:

- **Current approach:**
  - Reviewing the established models of variation order management that derived from the literature review to understand how they work and how they can be improved.
  - Investigating the current practice of variation order management by conducting a series of exploratory interviews to identify the criteria for managing variation orders in Saudi Arabia and to design the current conceptual model for the Saudi practice.
  - Determining the strengths and weaknesses in the current practice in Saudi public construction projects at the design stage to positively contribute to the model development.
- **Proposed approach:**
  - Developing the model based on the insights and results from the questionnaire survey, to achieve the study aim and objectives.
  - Testing and validating the proposed model by experts in the Saudi construction industry by carrying out focus group sessions to confirm the applicability, effectiveness and clarity of the model.

Figure 4.3 presents the stages of the model design.

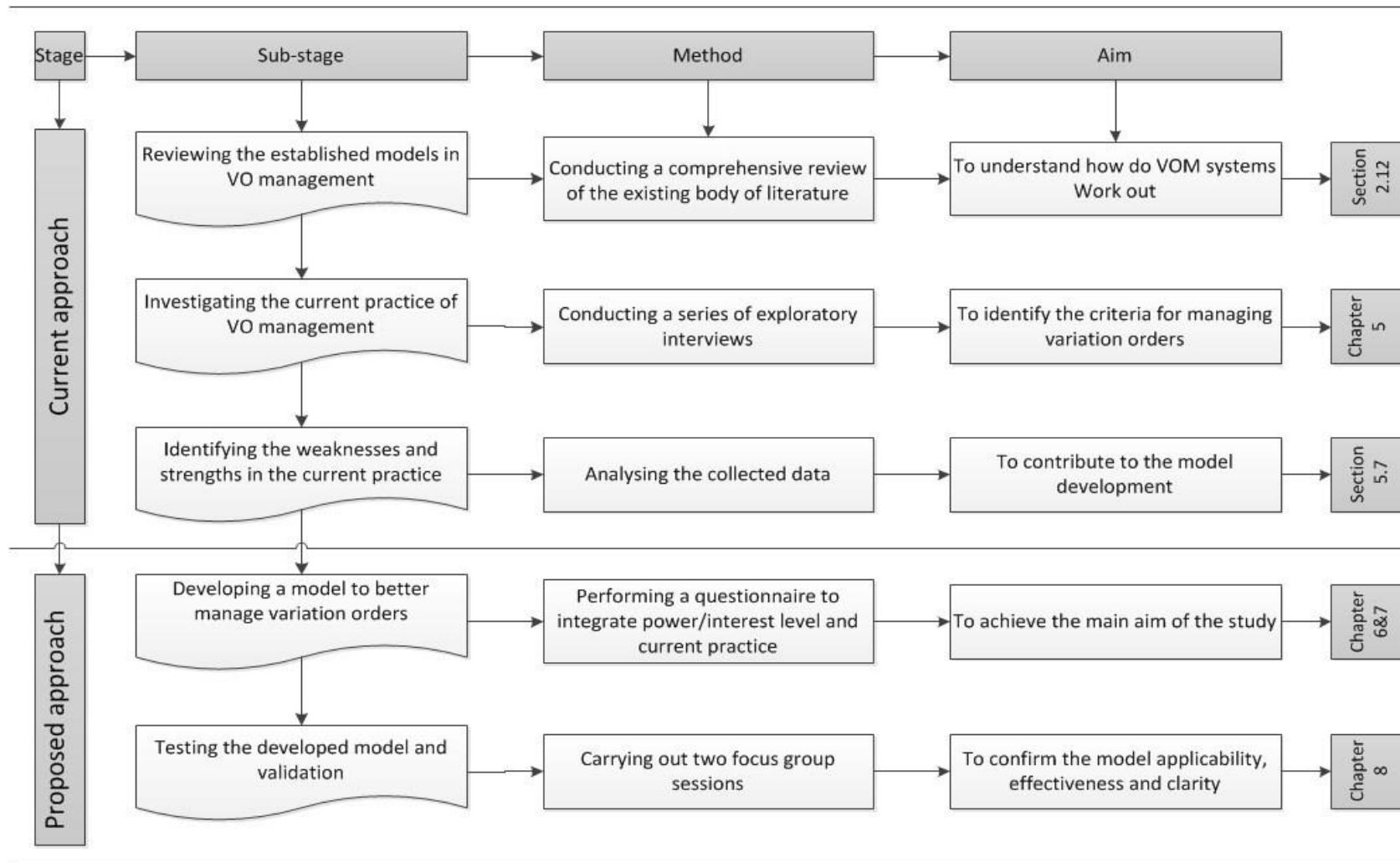


Figure 4-3 The model design process

Basically, the design of the proposed model is based on the current practice of the process of variation order management in Saudi public construction projects. However, a modification will be applied in this process by adding two different variables to each step of the current practice. These variables aim to explicitly identify the level of power and interest of the involved stakeholders, public client and consultant. This identification would assist the design team to shorten the time of managing variation orders and overcome the potential conflicts and disputes that can happen in the process of variation order management.

Moreover, in each step of the current practice of variation order management, a matrix will be designed to locate the stakeholders into the power-interest matrix. This matrix identifies the type of communication and relationship that the project manager requires to establish and maintain with the different types of stakeholders, illustrated for each type of stakeholder in four zones in the matrix, based on their level of power and interest.

#### **4.10 Summary**

This chapter has presented a synthesis of critical issues highlighted in the previous chapters of the study to shape a theoretical background to the research. Additionally, adopting a pragmatist view of the world has determined the philosophical position of the research. This researcher believes that knowledge building does not follow specific theories. Theories are developed by individual experiences or actions, circumstances and conditions. Hence, mixed methodologies were regarded as appropriate to achieve the research aim and solve the problem. Consequently, the study was conducted in three sequential stages. In the first stage an interpretivist research epistemology was adopted by applying an inductive approach with exploratory interviews to investigate the current practice of variation order management and build a conceptual model for it. In the second stage, adopting a positivist view, a deductive approach was used to verify the research propositions and develop a best practice model by conducting a questionnaire survey. In the third stage of this research, the interpretivist view was employed, again with an inductive approach, to validate and test the developed model through a focus group technique. Finally, this chapter explained the modelling techniques employed in construction research, the model design and the process to develop the proposed model.

## **Chapter 5 – Current practice of variation order management (Qualitative stage)**

### **5.1 Introduction**

This chapter explains the work carried out during the qualitative research stage. The aim of this chapter is to better understand the current practice of variation order management in the Saudi public construction industry. The chapter starts by describing and justifying the methodology adopted to carry out the qualitative research and explains the process of the qualitative method applied to achieve the qualitative study aims. This is followed by the design and aim of the exploratory interview and also the research sample and data collection. The chapter presents the interview process, research respondents, qualitative analysis process and study findings. From the information revealed by the findings, a model of the current practice of variation order management is designed. Additionally, the stakeholders are located in the power-interest matrix, based on their positions during the process of the current practice.

### **5.2 Qualitative research approach**

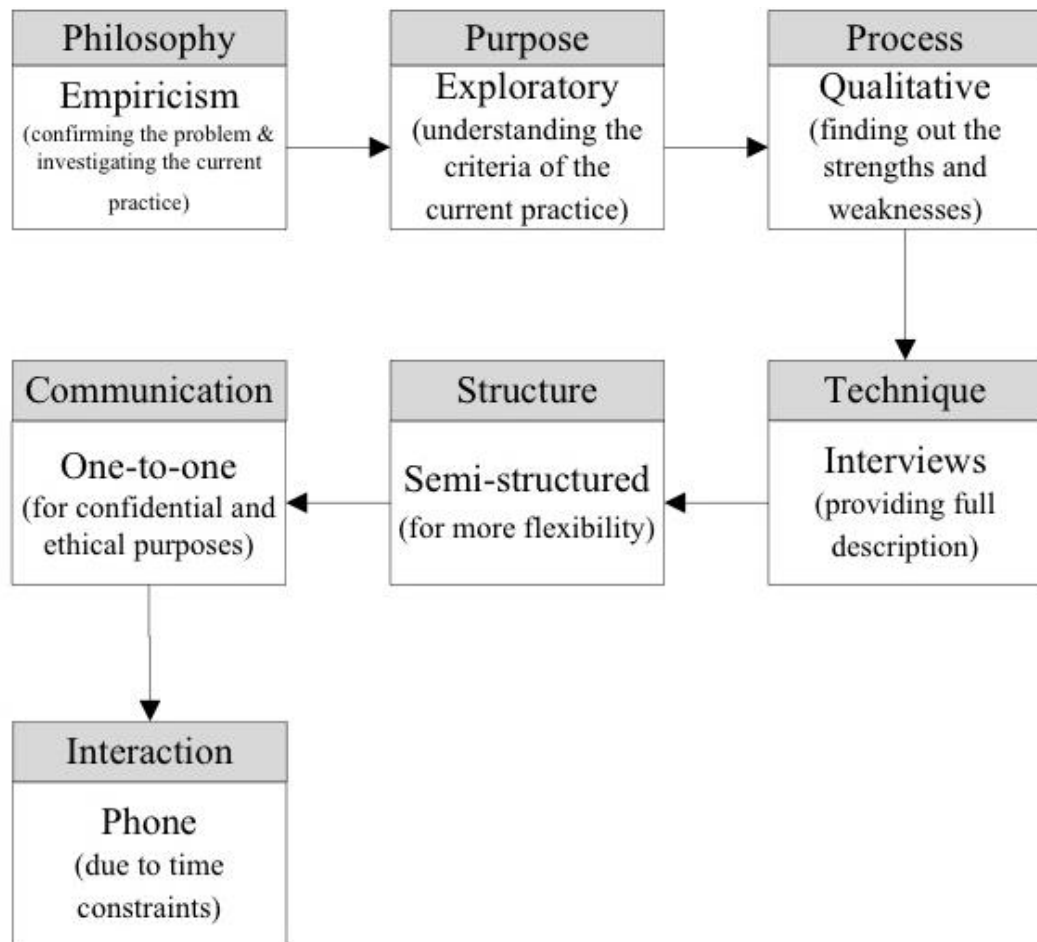
In order to adopt the most appropriate research approach, the researcher must first identify: what knowledge the researcher wishes to acquire; what is the required data to be collected; why the data are needed and what are the available and applicable sources to collect the required data (Falqi, 2011). In the early stages of the research process, a qualitative research approach is appropriate in order to fulfil the identified criteria.

Qualitative research is interpretative research, as the researcher's basis, values and judgment are stated explicitly. It is concerned with process instead of products or research outcomes. Furthermore, a qualitative research approach focuses on meaning rather than statistical inferences. In other words, it focuses on how people make sense of their experiences, lives and their world (Creswell, 1994). Qualitative research aims to build a theory, which would then be tested or validated (Glesne and Peshkin, 1992). This stage of the research involves gathering qualitative data, as the desired data concern a better understanding of the current practice of variation order management in the Saudi public construction industry. It is considered that the qualitative approach is the most appropriate approach for data collection at the stage of the research, due to



lack of sufficient information about the current practice of variation order management. However, several publications acknowledge the negative impact of variation orders in the Saudi construction industry (e.g. Al-Dubaisi, 2000; Al-Kharashi and Skitmore, 2009; Alshehri, 2012)

Fitting all the elements of the interview methods together, and linking them with the research aim can provide an overview of the whole situation of current practice. Figure 5.1 shows the research approach and perspective in the qualitative stage. This stage is rooted in empiricist philosophy, which is the solid grounding on which the research stands. From this stand, the qualitative research process can be finalised to find out the strengths and weaknesses of the current practice. The study then adopted the interview technique for data collection to provide full and accurate descriptions of the current practice. The interview was semi-structured, to provide more flexibility to the interviewer and interviewee. The communication of the interview was one-to-one for confidentiality and ethical issues. Finally, the interaction was through recorded telephone calls, to save the researcher time and money, as the research was conducted in the UK and the research case was in Saudi Arabia. The qualitative research approach was employed to confirm the research problem and the purpose of the research can be achieved.



**Figure 5-1 Perspectives of the interview for the research approach**

### **5.2.1 Research technique**

The experts in the investigated area are the available and applicable data sources. Hence, the data collection was achieved by carrying out a number of interviews with carefully selected people. Glesne and Peshkin (1992) state that in a qualitative research technique reality is socially constructed, which means that data is obtained through people. In this instance, in order to collect data for the purpose of this research, interviews were the only appropriate method. The other qualitative methods for collecting data, such as case studies, were either unsuitable for this research or not accessible to the researcher.

As this stage of the research was designed to better understand the current practice of variation order management in the Saudi public construction industry, it had to be borne in mind that one of the qualitative interview characteristics is that the researcher may have not enough knowledge or a clear picture about the area being investigated (Naoum, 2007). This explains why the qualitative method is most recognized as an exploratory method.

### **5.2.2 Interview approach**

The interview is one of the most widely employed approaches for collecting qualitative data. Definitions of an interview are rich in the literature. According to Kvale (1996) *“An interview is literally an inter view, an inter change of views between two persons conversing about a theme of mutual interest”*.

Several approaches have been developed in order to carry out interviews, with diverse names and meanings. Therefore, in order to avoid confusion the following sections explain interview types and classification, as well as identifying the approach applied in the research and explaining the reasons for the methods that have been selected.

### **5.2.3 Interview structure**

According to The Society of Applied Anthropology (1954) there are three main types of interview structure, which are *“structured, semi-structured and unstructured interviews”*. The structured interview has a fixed set of questions and the questions are asked exactly as designed and prepared (Kumar, 2005).

On the other hand, the semi-structured and unstructured interviews deploy open-ended questions. They aim to obtain genuine responses to discover people’s perspectives, opinions and experiences. The phenomenon being examined is often complex and multidimensional, which means information is not easily obtained through other methods such as the questionnaire or structured interviews (Becker and Bryman, 2004). In semi-structured interviews, the researchers have a predetermined set of themes and topics to discuss with interviewees (Fitzpatrick and Boulton, 1994). In contrast, in unstructured interviews, the researchers follow no predetermined structure, although they may have some ideas in terms of the general phenomena being investigated. An unstructured interview might be hard to direct and need a highly skilled interviewer.

In this research, the semi-structured interview is applied. The structured interview is not a useful method for building concepts and exploratory research. The unstructured interview is more appropriate for investigating and understanding a general area (Saunders et al., 2009). However, unstructured interviews can be time consuming and more than one interview with each respondent may be needed, due to the lack of structure.

The semi-structured format of interviews is fixable and manageable and questions can be changed or added, depending on the interview situation. Moreover, the semi-structured interview provides a good opportunity to qualitatively make observations that will assist in the subsequent development of the research.

#### **5.2.4 Communication and interaction methods**

There are two different types of communication methods to conduct an interview, “one-to-one” and “one-to-many” (Powney and Watts, 1987). For confidential purposes, one-to-one interviews were adopted in this research. As Powney and Watts (1987) point out, the one-to-one approach is *“easier to manage; issues can be kept relatively confidential, analysis is more straight forward in that only one person's set of responses are gathered at any one time”*.

Interviews can usually be categorised based on the method of how the interviewer and interviewee interact. There are a number of types of interactions, which are suitable for interviews. The most common methods to interact are face to face, by phone and through the Internet (Gubrium and Holstein, 2002). In this research, a phone call is the method of interaction, to speed up the process of the qualitative research, as the research was carried out in the UK and the research case was in Saudi Arabia. Therefore, in order, phone call was the most appropriate method to interact.

### **5.3 Process of the qualitative method**

Exploratory research interviews were performed with two different parties in the Saudi construction industry. As the desired aim of the research is to provide a better management for variation orders in the Saudi public sector construction projects at the design stage, only public sector clients and consulting firms were involved in the exploratory interviews. The interview questions were designed based on the literature review with regards to variation orders management and the Saudi construction industry.

The data collected from respondents from both parties were analysed qualitatively. The research findings emerged after analysing the responses that confirmed the research problem and framed the next stage of the study.

### ***5.3.1 Exploratory research method***

Exploratory research can be classified as a part of the qualitative research method (Naoum, 2007) and is defined by Given (2008) as “broad-ranging, intentional, systematic data collection designed to maximize discovery of generalizations based on description and direct understanding of an area of social or psychological life”.

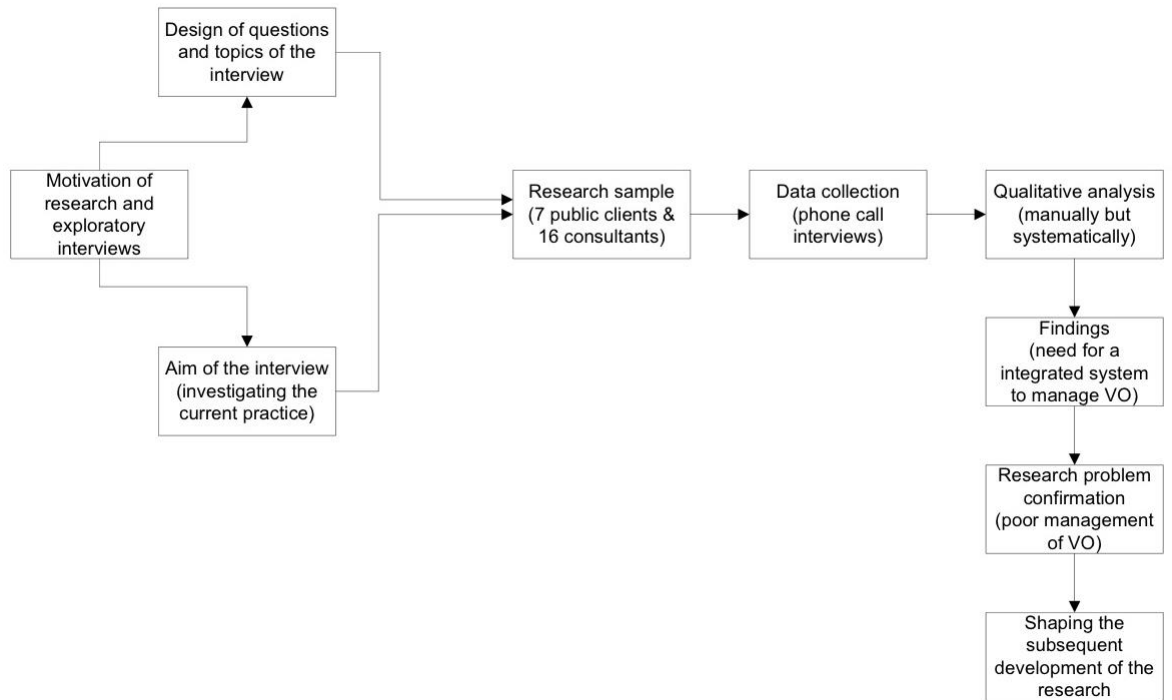
According to Naoum (2007) researchers use exploratory research when they do not have enough amount of knowledge about the topic or the problem. Exploratory research aims to formulate clear and accurate statement for the recognized problem. Walliman (2005) further explains that exploratory research is conducted when investigating a new and not previously recognized issue, topic or problem. It is considered that exploratory research holds greater risks, as it requires more expertise, knowledge and experience on the part of the researcher and, requires support from the supervisor as well (Walliman, 2005). According to Zikmund (1997), researchers carry out exploratory research for three interrelated aims which are (a) to diagnose a situation, (b) screening alternatives and (c) discovering new ideas. The interview technique is a commonly selected data collection method in this type of research.

### ***5.3.2 Exploratory interview process***

In exploratory research, a framework for the research process should be designed and followed. Figure 5.2 explains the steps of the exploratory research carried out to investigate the current practice of managing variation orders in Saudi public sector construction projects at the design stage.

Due to the lack of data regarding the Saudi context, the process starts with defining the exploratory research and the problem that motivated the researcher to conduct it. Following that, the exploratory research aims were identified (see section 5.3.3), meanwhile the questions were designed (see appendix A). After that, the research sample was allocated for the research purposes (see section 5.3.5). Following these steps, the data was collected through recorded telephone call interviews. The collected data was then analysed and the findings confirmed the research problem (see section

5.4). Finally, these findings shaped the subsequent development of the research.



**Figure 5-2 The exploratory research process**

### 5.3.3 Aim of the exploratory interviews

The lack of knowledge about management of variation orders in Saudi Arabia and the limited published work in relation to variation orders in the Saudi construction industry, led the researcher to carry out a series of exploratory interviews. The aim of the exploratory research is to better understand current practice of variation orders management at the design stage of public sector construction projects in Saudi Arabia. To achieve this, the objectives of the interviews were as follows:

- To identify the criteria for managing variation orders in Saudi Arabia
- To explore the existing models/frameworks to manage variation orders
- To find out how models/frameworks for variation orders work in Saudi Arabia
- To investigate the problems associated with these models/frameworks for variation orders in Saudi Arabia
- To confirm the research problem
- To design the current conceptual model of variation order management
- To frame the criteria of the main study of the research

#### **5.3.4 Design of the exploratory interviews**

As a part of the preliminary data collection method, semi-structured interviews were designed in order to carry out the exploratory research. According to Bryman and Bell (2003) the interview approach is most common likely research technique in the qualitative method, as it provides a flexible method that can be adopted to collect significant ideas and comprehensive opinions to enrich the research. The semi-structured format of the interviews provides a good opportunity to qualitatively make additional observations that would confirm the need for this research and assist the subsequent development of the research. In this case, the interviews were performed to investigate the current practice.

The exploratory research questions were formulated from the literature review on variation order management and the Saudi construction industry. The semi-structured interview consists of fourteen questions divided into three main areas, which concerned: (a) personal background, (b) management of variation orders in Saudi Arabia and (c) existence of models/frameworks to manage variation orders in Saudi Arabia (see Appendix A). However, the interviewees were given some flexibility in order to discuss their opinions and experience in managing variation orders. This means some additional questions might be asked, based on their descriptions. Kendall and Kendall (2002) suggest that this technique may encourage the interviewees to add more valuable and important details to the interview questions. The exploratory interviews are necessary to frame the main study of the research by investigating the current practice of variation orders management and confirming the research problem.

An interview guide (see Appendix B) was designed, in order to develop the interview questions (see Appendix A); the guide was divided into four sections as follows:

- Interview topic;
- Questions;
- Objectives of the questions; and
- Response analysis

These four sections of the interview guide ensured that the right questions were addressed and asked, and also how the questions would be evaluated and analysed.

It was crucial in designing interview guide to ensure that the interview topic follows an order which would facilitate moving between questions. For example, asking general questions about management of variation orders at the design stage, led to asking questions about the approaches employed to manage variation orders.

#### **5.3.5 *Research sample***

Interviews can be the most suitable technique for collecting data on industrial practices (Dawood and Dalaklides, 2002). In these types of research, the research samples are mostly small (Corti and Thompson, 2004) and Silverman (2001) argues that in order to collect sufficient and reliable data, at least six interviews would be needed.

In order to enrich the survey and produce the most significant results, it was determined to involve two types of participants, the public sector clients and the consulting firms in the Saudi construction industry. The public sector clients were the Saudi Ministries that have construction management departments. The selected respondents of the public clients were project managers and/or client representatives for building construction projects. According to the Ministry of Civil Service (MCS) (2011) there are 16 public construction departments in the different Saudi Ministries. The researcher attempted to contact all of them to be interviewed for the purpose of the research. However, only 7 agreed to participate in the study.

On the other hand, the consultants were merely the consulting engineering firms certified by the Ministry of Municipal and Rural Affairs in Saudi Arabia. According to MOMRA (2011), there are 202 certified consulting engineering firms that cover most regions of Saudi Arabia. The selected respondents from the consulting firms were design and/or project managers. However, some of these firms do not have contact details at the MOMRA website; also some of them do not deal with public sector projects and some of them are out of the researcher's reach. Hence, in order to get an appropriate sample, the data was collected firstly from the public sector representatives; the representatives were asked about the most common consultancies they deal with. Then, from their feedback the sample of the private consulting firms was identified and 16 consulting firm showed interest in participating in this study.



Another point worth noting is that, in the exploratory interviews, the respondents were from different organisations and different construction projects, for both public bodies and private consulting firms. The purpose of this diversity is to look into different perspectives, issues and experiences from the respondents, and also to gain valuable diverse data to shape the later stages of the research.

### **5.3.6 Data collection**

The data was collected through recorded phone calls with the interviewees in order to save the researcher's time in obtaining all the required data to confirm the problem and to shape the questions of the main study before conducting the fieldtrip to Saudi Arabia. In this regard, Fellows and Liu (2008) state that *"Often, with permission of respondent, tape recording the interviews can be very helpful at later stages of analysis and, through subsequent scrutiny, help to ensure accuracy and objectivity in recording responses. Transcribing is lengthy, tedious and expensive so the tape recording may be employed to supplement the interviewer's notes."*

#### **5.3.6.1 The respondents of the exploratory research**

The respondents of the exploratory interviews were 23 in total, 7 respondents from different public sectors and 16 from different consulting firms in Saudi Arabia. The interviews were performed in the last quarter of 2011. All the selected consulting firms were recommended by public sector clients.

The interviews were carried out through recorded phone calls using a smart phone. The total time spent on interviews was 710 minutes, with an average duration of 31 minutes for each interview, and the spoken language was Arabic. The recordings were also transcribed as word documents. The details of the respondents and their sectors are shown in Table 5.1.

**Table 5.1 Respondents details**

Interviews	Sector	Position of the respondent	Years of experience	Location (City)	Duration of the interview
1	Public	Head of project management department	22	Riyadh	50 min
2	Public	Vice-project manager	18	Riyadh	35 min
3	Public	General project manager	26	Riyadh	30 min
4	Public	Head of construction and facilities management	28	Makkah	40 min
5	Public	Project manager	21	Jeddah	35 min
6	Public	Project manager	31	Riyadh	35 min
7	Public	Construction project director	21	Jeddah	25 min
8	Consulting firm	Design manager	32	Jeddah	45 min
9	Consulting firm	General manager	26	Riyadh	30 min
10	Consulting firm	Design director	11	Jeddah	35 min
11	Consulting firm	General design manager	18	Jeddah	30 min
12	Consulting firm	Design manager	20	Jeddah	25 min
13	Consulting firm	Regional design manager	17	Jeddah	35 min
14	Consulting firm	Head of design department	32	Jeddah	45 min
15	Consulting firm	General manager	21	Riyadh	20 min
16	Consulting firm	Design director	26	Jeddah	25 min
17	Consulting firm	Architect	11	Jeddah	15 min
18	Consulting firm	General manager	26	Dammam	20 min
19	Consulting firm	Design director	19	Jeddah	25 min
20	Consulting firm	Architect	16	Riyadh	40 min
21	Consulting firm	Head of project planning	18	Jeddah	30 min
22	Consulting firm	General manager	26	Riyadh	30 min
23	Consulting firm	Design director	11	Dammam	25 min

#### 5.4 Interview analysis steps

The data collected from the semi-structured interviews were analysed manually but systematically, as described by Ritchie et al. (2003). The analysis steps are shown in Figure 5.3 and described in the following sections:

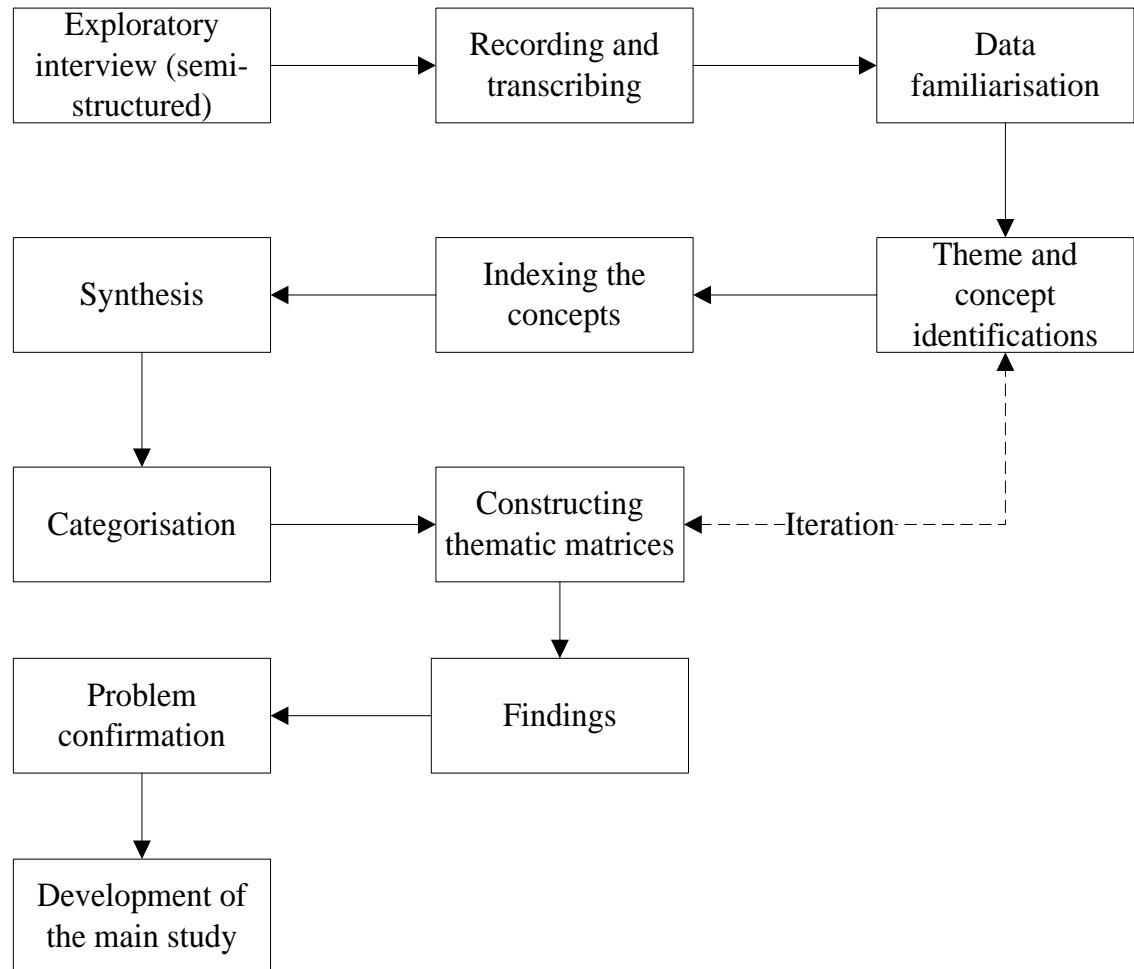


Figure 5-3 The process of interview analysis

- **Recording and transcribing:** In order to facilitate analysis the first step was to record and transcribe the interviews, using the interview guide as a structure (see Appendix B).
- **Familiarising the data:** After the step of transcribing the interviews, the next step was familiarisation. According to Ritchie et al., (2003) familiarisation is a fundamental step at the start of the qualitative analysis to build the foundation of the analysis structure. In this stage the recordings were listened to again and the transcripts of all interviews were carefully read to support the familiarising process and in order to assist the qualitative analysis.

- **Theme and concept identification:** Themes and emerging concepts during the process of familiarising the data were carefully listed and noted. A point worth noting is that the interview guide provided wide range of themes based on the interview questions and objectives. In fact, the semi-structured interview allowed the interviewees to open a new range of themes and relevant concepts during discussions to support the development of variation order management approaches in the Saudi public construction projects. Examples of the themes and emergent concepts during the qualitative analysis are shown in Table 5.2.

**Table 5.2 The themes and concepts identified**

Themes	Emergent concepts			
Negative effects of variation orders	Major cause of delay	Disputes and conflicts among project parties	Bad reputation and relationship	Cost overruns and quality defects
Current procedure of variation orders management	No formalised technique	Not enough awareness to manage and document variation orders	Lack of knowledge, experience and written procedures	Insufficient details and poor management
Criteria of variation order management	Each party has its own criteria	No agreed criteria	Most variation orders are managed by negotiation	Absence of scientific approaches and technology
Benefits of applying variation order management system	Document variation orders and learn from them	Would assist project parties	Providing value analysis	Assist in avoiding unforeseen design errors

- **Indexing the concepts:** The next step after identifying the themes and emergent concepts was to locate links between the concepts and themes to provide a hierarchy and grouping of the collected data. It was imperative during the qualitative analysis to filter the responses and to sort the themes and emergent concepts into an index of hierarchy. Carrying out this step also assisted in presenting and discussing the interview results. Table 5.3 illustrates an example of indexing the concepts that was conducted during the qualitative analysis.

**Table 5.3 An example of indexing the concepts**

Challenging of applying a variation order management system

- Client issues
  - Lack of knowledge and experience in dealing with managing variation orders
  - Lack in the governmental contract terms and conditions
  - Poor definition of project management scope and objectives
  - Lack of training courses and workshops in good project management practices
- Consultant issues
  - Insufficient details of variation orders and poor management
  - Lack of trust of public clients
  - Poor co-ordination and lack of effective communication with public clients
  - Changes at late stages highly affect the design
  - Changes in one discipline affect the design descriptions in other discipline

- **Synthesis:** After completing the step of indexing the concepts, it was essential to summarise and synthesise the data to reach to a more controllable level and also to extract the findings through the themes and emergent concepts from the previous qualitative analysis steps. Moreover, during this step it was also imperative to retain and consider the key terms and phrases of the respondents, as much as possible, in their own language. Also, in this step interpretation was kept to a minimum to provide an opportunity to revisit the original expressions of the respondents. The synthesis step provided a brief presentation of the data revealed from the exploratory interview analysis.
- **Categorisation:** The next stage of the qualitative analysis was categorising the synthesised data to allow refinement and assignment of the descriptive information. Moreover, the categorisation was required to pack the collected data under a higher level of abstraction.
- **Constructing a thematic matrix:** This stage of constructing a thematic matrix was an iterative process, as can be seen from Figure 5.4. The iterative process involved going between the themes and concept identification stage and constructing a thematic matrix. This stage of qualitative analysis summarises the main points of each piece of information. The process of constructing the thematic matrix places each set of data in a row and each subtopic in a column

in the matrix. However, creating a thematic matrix needs extreme care with regards to the amount and content of the collected data. The constructed thematic matrix from this stage is included in Appendix (C).

- **Analysis of findings:** After the categorisation of the synthesised data, the next step was allocating the findings revealed from the previous qualitative analysis steps. The findings of the exploratory research interviews carried out with the public clients and consulting firms in the Saudi construction industry to investigate the current practice in managing variation orders at the design stage are divided into three main parts, which are common findings, findings of consulting firms and findings of public clients, as summarised in Table 5.4.

**Table 5.4 The findings of the qualitative analysis**

<ul style="list-style-type: none"> <li>• <b>Common findings</b> <ul style="list-style-type: none"> <li>○ Variation orders negatively affect the progress of the design stage.</li> <li>○ Variation orders lead to delay, cost overruns and quality defects.</li> <li>○ No formalised method is applied to manage variation orders in either public sector or consulting firms at the design stage of Saudi public construction projects.</li> <li>○ High occurrence of variation orders affects the firm's or department's reputation.</li> <li>○ A considerable lack of knowledge in dealing with design change management.</li> <li>○ Lack of awareness with regards to variation order management.</li> <li>○ Adopting an appropriate change order management system would assist both public clients and consultants to identify variation orders, analyse, evaluate, implement and document them.</li> <li>○ Both detrimental and beneficial variation orders need to be managed effectively.</li> <li>○ The absence of a variation order management system leads to poor relationships among the project parties.</li> <li>○ Culturally- related issues lead to not adopting a change management system.</li> <li>○ Stakeholders' responsibilities are not clear enough with regards to the change process.</li> <li>○ Public clients and consulting firms should be aware and educated</li> </ul> </li> </ul>
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about good change management practices in the construction industry.

- Stakeholder engagement is not clearly understandable during the change management process.
- Inaccurate cost and time estimation due to ineffective analysis and evaluation.

- **Findings of public clients**

- Public clients assume that variation orders are normal and expected to occur. Also, variation orders are easily managed.
- Poor definition of project management, scope and objectives
- Public clients state that they do not face any obstacles or serious problems with consulting firms with regards to variation orders.
- A considerable lack in the governmental contract terms and conditions, notably with variation order management.
- Public clients suffer from lack of experience in dealing with the procedures of applying design changes.
- Public sector clients do not assist consulting firms to clearly define the aim of the variation order in order to review, analyse, implement and document these variations.
- Lack of workshops and training courses in good management practices.
- Poor co-ordination and lack of effective communication with public clients.
- Public clients suffer from a lack of professionally qualified engineers.

- **Findings of consulting firms**

- Insufficient details and poor management of variation orders that occur at the design stage not only affect the design progress they also affect the construction stage.
- Variation orders frequently lead to design errors.
- Consultants initiate design changes without consulting the client.
- Unnecessary interactions by public clients during managing and implementing the variation order.
- Consultants strongly agreed on the importance of applying a proper method to manage variation orders.
- Changes at late design stages frequently affect design progress, due to

changes occurring in one discipline commonly affecting design descriptions in another discipline.

- The client does not pay enough attention to the consultant's decisions.
- Variation orders strongly affect design productivity.
- Time taken to implement design changes depends on the change itself.
- Consulting firms suffer from lack of effective design and review processes.
- Training courses, the variation process and terms of contract need to be considered before adopting a change management system.

- **Problem confirmation:** It can be seen, from the analysis of the exploratory interviews, that the respondents believed that the tasks of the parties involved in construction projects at the design stage in Saudi Arabia are not yet clearly identified and understood with regards to variation order management. This issue could be attributed to the fact that there are currently no formalised approaches to manage variation orders during the design process. The participants in the study strongly emphasised the lack of stakeholder engagement and interaction during the variation order management process, which leads to poor management. Furthermore, they felt stakeholders' responsibilities are not clear enough with regards to the change process. These issues must be taken into account in order to assist the engagement of stakeholders and educate all parties about the importance of stakeholder engagement in the design phase to manage variation orders effectively. This finding confirms the results obtained by Almazyad (2009), who carried out a study in which he states that the tasks and activities of construction projects in Saudi Arabia are not yet well explained and identified among the project parties. Moreover, it can be clearly seen from the interviewees in the public sectors that the scope of any construction project is not clear enough for the public clients, notably with regard to project variations. Here, the considerable lack of knowledge in relation to change management practices can be clearly noticed. This finding adds weight to Al-sudairy's (2001) argument, which states that the system of change management is relatively new in the Saudi construction sector and is not yet well established. Analysis of the data also revealed a significant



lack of knowledge and experience of the management of change orders in Saudi construction projects, which led to several problems that could easily be associated with variation orders. This result agrees with that of Alkhalil and Alghafly (1999), who found that changes are one of the major causes of delay in the Saudi construction industry. Similarly, the survey conducted by Al-sultan (1989) identified that at that time there was no systematic engineering approach, or at least no formal procedure followed by the public sectors in Saudi Arabia, to set the contract duration for public construction projects. Hence, participants in the current study, both public clients and consultants, strongly suggested a need for adopting a change order management system at the design stage to assist them in overcoming problems and managing changes effectively.

- **Development of the main study:** The last step of the qualitative analysis involved developing the main research study to provide a better system for management of variation orders, based on the findings and results of the exploratory interviews. For the purpose of the research, a quantitative research method will be employed for the next study stage, to obtain the maximum amount and quality of data. As a result of the reported lack of engagement among stakeholders during the variation order management process, which was considered to have caused poor variation order management, a questionnaire survey will be designed in order to investigate the importance of stakeholder engagement and interaction, to better apply the current practice of variation order management in the Saudi public construction projects. Moreover, this survey will integrate a power-interest matrix with the current practice for the involved stakeholders (public client and design consultant) to identify the level of power and interest for each stakeholder in each process of the current practice. The quantitative research sample will be also public clients and consulting firms. However, the sample population of the quantitative survey will be much wider than the qualitative interviews, to come up with significant findings.

## **5.5 Discussion with the interview respondents**

This section presents the key findings of the discussions with the interview respondents from both public sectors and consulting firms, in terms of the current practice and existing models or frameworks to manage variation orders effectively. Additionally, this

section demonstrates the current conceptual framework of variation order management in the Saudi construction industry at the design stage.

### **5.5.1 Public sector respondents**

Generally speaking, most of these responses were almost identical due to all public construction projects in Saudi Arabia implementing the Standard Public Works Contract (SPWC), designed and prepared by the Ministry of Finance and National Economy in 1988. The responses in this section are presented according to the interview guide in terms of the current practice and the existing models or frameworks to manage variation orders.

#### **5.5.1.1 Current practice of variation orders management (Public clients' views)**

This section explains the current practice of variation orders management in the Saudi public construction projects at the design stage from the perspectives of the public sector clients. It aims to better understand the current practice of variation order management in Saudi Arabia, to evaluate the criteria of variation order management and to examine the problems with managing variation orders currently, from viewpoints of both the public sector clients and consulting firms.

- **Negative effects of variation orders**

The public sector participants answered the first question in this section; “How do variation orders negatively affect the progress of the design stage, regardless of whether the variation order is beneficial or detrimental?”

*“Variation orders have a significant negative impact at the design stage that highly affect the progress of the design because they lead to delay in the design duration, cost overruns, quality defects and in some cases variation orders lead to disputes and conflicts among the projects parties. About beneficial variation orders at the design stage, they absolutely save the project cost and time, especially in the construction stage; however they need time to be implemented and managed effectively, which can affect the completion time of the design”*

All respondents emphasised the negative impact of variation orders. An important response pointed out that beneficial variation orders also need to be managed effectively to achieve their aims.

- **Management of variation orders at the design stage**

The public sector respondents were asked the second question in this section which was: “How do you manage variation orders at the design stage?”

*“Actually we have no certain or formalized technique that is implemented in our construction projects to manage variation orders at the design stage or even at the construction stage. I think variation orders are normal and easily managed, especially that we have a good relationship with the appointed consultants from our previous projects”*

*“Inaccurate cost and time estimation for variation orders from the design consultant can cause severe disputes and conflicts in the design stage and subsequent stages with different stakeholders”*

This study revealed that project managers in the public sector consider that variation orders are normal and expected to occur at any stage of the project, if not all. Moreover, project managers believe variation orders are easily managed, in their experience. However, public clients also report that they suffer from inaccurate estimations from the consultant.

- **Problems associated with variation order management**

The following question was about identifying the problems associated with the management of variation orders at the design stage and how the public sector clients overcome these problems.

*“As we said previously variation orders are easily managed using our experience, which means that we do not face any obstacles or serious problems with consulting firms with regard to the occurrence of variation orders, because the cost of the design is agreed and signed, which includes the cost of the design changes ...”*

*“Actually we deal with limited consulting firms, and that means we know them very well from our previous projects which assists us to work with them efficiently. However, problems occur when we initiate variation orders after the design has been finalised and agreed for several causes, such as additional works to the design; in this case we sign a new contract with the consulting firm”*

*“Some problems appear during the process of implementing the variation order that lead to time delay due to the lack of stakeholder engagement and interaction appropriately between us as public clients and the design consultants. This problem must be considered to help us to manage the variation orders effectively”*

From the above statements, the lack of awareness of variation order management and project management practices can be clearly noted. The public client respondents attributed this problem to the lack of workshops and training courses for the project team in good project management practices. An important point revealed by the study was that the lack of a competitive process to appoint the consulting firm led to poor management of variation orders. Some respondents declared that insufficient details and poor management of variation orders that occur at the design stage not only affect the design progress, but they also affect the construction stage, due to the absence of change management practices. The last point worth noting in this section is that the poor level of stakeholder engagement and interaction in the process of variation order management was perceived to cause delays in implementing the variation order effectively.

#### **5.5.1.2 Existing models or frameworks (Public clients' views)**

This section shows the existing models or frameworks that are applied in public construction projects to manage variation orders. This section aims to identify the existing model or frameworks used to manage variation orders at the design stage and to determine the problems with applying these techniques. It also aims to investigate the importance of adopting and developing a model or framework and understand the challenges of applying a variation order management system.

- **Methods used to manage variation orders**

This study confirmed that there is no existing model, framework or IT software to manage variation orders at the design stage.

*“Honestly, we do not have any existing model, framework or IT software to manage variation orders. We do not know if there is currently an appropriate approach to manage variation orders at the design stage effectively that might save the design duration or assist to implement the variation orders efficiently and appropriately. However, we apply some basic criteria to implement variation orders”*

From the public sector respondents, the lack of knowledge in managing variation orders and change management system practices can be clearly seen. However, there is a conceptual framework that is a likely common practice to manage variation orders at the design stage. This common practice will be explained in section 5.5.3.

- **The importance of applying a change management system**

In addition to this section, the main key finding from the public sector respondents is their discussion of the need to adopt an appropriate approach to manage variation orders at the design stage efficiently. Moreover, some of the public sector respondents argue the importance of identifying stakeholders’ responsibilities in the change order management system.

*“I think if we apply certain criteria to manage variation orders that would help us, firstly, to better understand the need for the variation order. Then would help us to identify, analyse and evaluate, implement and document the variation order. Also that would help us to avoid unforeseen design errors”*

*“The implementation of a variation order management system with identification of stakeholders’ responsibilities will help both of us as public clients and designers to work together effectively”*

### **5.5.2 Respondents from consulting firms**

This section presents the responses of the consulting firms. In fact, the responses of the consultants were quite similar to each other. However, their responses were totally different in many respects from those of the public sector clients although there was some similarity in a few respects. The responses here are also presented according to the interview guide (see Appendix B).

#### **5.5.2.1 Current practice of variation order management (Consultants' views)**

In this section the researcher intends to explain the responses of the consulting firms in terms of their current practice for managing variation orders in the Saudi public construction projects at the design phase. The aims of this part of the interview were mentioned previously, in section 5.5.1.1.

- **Negative effects of variation orders**

All the respondents from the consulting firms stated that variation orders are unwanted and agreed on the significant negative impact of variation orders and their management.

*“We really suffer from variation orders and their possible negative effects on the design progress. Both beneficial and detrimental variation orders affect the design progress. However, detrimental variation orders have much greater negative impact on the design phases. Actually, variation orders are the major cause of delay in the Saudi construction industry”*

Respondents from consulting firms emphasised the negative effects of design changes and blamed variation orders as the main cause that leads to design delay.

*“Even beneficial variation orders need to be managed effectively”*

This statement adds weight to the finding of the respondents of the public sector clients with regards to managing beneficial variation orders.

- **Management of variation orders at the design stage**

An important issue pointed out during the interviews with consultants concerned the criteria for variation order management at the design stage in the Saudi public construction projects.

*“In fact, we have no approved method to manage variation orders during the design phase. We want to have an appropriate method that helps us to better manage variation orders in order to improve our productivity to meet the client requirements. The*

*problem is that public sector clients do not assist us to apply a change management system, due to their lack of knowledge in change management practices”*

*“However, we manage variation orders in our consulting firms by following a straightforward process which are identifying the change, estimating the cost and time of the change order, analysing and evaluating, approving the change, implementing and documenting the change”*

From the above statements it can be seen that consulting firms are, to some extent, aware about change management system practices in the construction industry. In contrast, public sector clients showed lack of awareness of change management practices.

*“Another important point to mention is that the time for implementing design changes depends on the change itself. In other words, some changes need few minutes to be implemented and others need weeks or even more time depending on the size of the change orders and the affected disciplines. Also, variation orders at late design stages extremely affect the design progress because changes that occurred in one discipline affect design description in other discipline”.*

Here the representatives of the consulting firms highlighted the two different issues: firstly, the time needed to implement variation order differs from variation order to other; secondly, the importance of avoiding the occurrence of variation orders at late design process, to avoid the changes in other disciplines that might lead to design errors, in the absence of change order management systems.

- **Problems associated with variation order management**

Respondents from consulting firms were asked about the problems associated with variation order management and how these problems are overcome. The following different problems were pointed out in this respect:

*“We have reported and discussed the problems associated with variation orders with the public sector clients many times. Also, we discussed the difficulties that we face to implement the initiated variation orders effectively. However, due to the bureaucracy of*

*the public sectors we have not received any response from them and they have not paid any attention to the negative impacts of variation orders. This issue due to their being powerful in the design process as they are the owners”*

*“Poor management of variation orders not only affects the progress of the proposed project design itself; they also affect the progress in our other different projects. Also, poor management of the variation orders at the design stage affects the performance of the project during the construction phase, as well due to some design errors appearing during the construction phase because of the absence of design and change management during the design phase”*

*“As design consultants we suffer from public client unneeded interactions during managing and implementing the variation order. These unneeded interactions because the tasks for both parties in the design stage are not clear enough and understandable. Also, the stakeholder involvement needs to be improved, notably in the design change process, to minimise the negative impact of the variation order and to achieve the variation order’s objectives. The lack of stakeholder engagement during the variation order management leads to some negative issues such as delay in implementing the change, design errors, high cost of the change and a bad reputation for both public clients and consultants. The real problem that we have now, the public clients give the consultant a minimal effort in managing design changes. Also, I think, by identifying the responsibilities of each party in each step that would highly improve the variation order management workflow”*

*“The lack of effective communications and poor co-ordination with public sector clients highly affects the management of variation orders and also influences the occurrence of variation orders”*

*“Public clients do not give enough attention to the consultant’s decisions with regards to the variation order cost and time”*

*“In some cases, for minor variation orders that do not affect the design or the project scope, we implement them without getting the approval from the client”*



*“Another problem associated with managing variation orders is that the Standard Public Works Contract (SPWC) does not cover the design process; also it has clear shortcomings in the regulations and instructions of the variation order, as it does not explain the types, causes of initiating variation orders or even the allowed amount of the variation orders’ cost and time”*

As can be clearly seen, the consulting firms complain about the bureaucracy of the public sector bodies in adopting a proper approach to avoid the problems associated with implementing variation orders. Furthermore, consulting firms complain about the poor management of variation orders, the lack of effective communication and poor co-ordination with public sector clients. Here, several design consultants emphasise how they suffer with public clients due to their interference during the management and implementation of variation orders. According to them, the stakeholder engagement and interaction in the variation order management process must be managed appropriately and effectively during implementation of the variation order, in order to minimise the possible negative impact and to improve the workflow to achieve their objectives.

#### **5.5.2.2 Existing models or frameworks (Consultants’ views)**

This section presents the existing models or frameworks in the consulting firms for variation order management in the Saudi public construction industry. The aims of this part were explained previously in section 5.5.1.2.

- **Using a method to manage variation orders**

Based on the answers of respondents from the consulting firms, there is no existing model or framework to manage variation orders at the design stage. Nevertheless, there is a conceptual model that is a likely common practice to manage variation orders at the design stage in the Saudi public construction projects, which will be explained in section 5.5.3.

*“Frankly speaking, we have no particular technique that is adopted in our consulting firms to manage variation orders”*

- **Reasons for not using a variation orders system**

Respondents from the consulting firms gave several reasons for not employing a change order management system, which are:

*“Scope of the project is not clear enough to the public clients with regards to project changes, which means the occurrence of variation orders is significantly high, also the causes of the variations are not clearly identified”*

*“Public clients suffer from lack of knowledge and experience in dealing with the procedures of applying design changes”*

*“Public clients initiate numerous variation orders in each progress meeting, without having a clear definition for the aim of the change to assist us to review, analyse, implement and document these variations”*

*“Public clients request us to apply these changes without delay within the design duration and at no cost overrun”*

*“A considerable lack of written-down procedures in the governmental construction contracts to explain, regulate, control and manage the occurrence of variation orders at the design stage”*

Another response by the consultants worth noting in this respect is that:

*“Public sector clients must be educated about change management system practices in the construction industry: that would extremely assist in applying good project management practices in order to fulfil the project objectives”*

- **The importance of applying a change management system**

Here the respondents of the consulting firms strongly recommended the implementation of a variation order management system in the Saudi construction industry.

*“We strongly agree on the importance of applying a proper method such as a model, framework or IT software to manage variation orders at the design stage effectively”*

*“Also, we highly recommend that adopting an appropriate change order management system would assist both public clients and consultants to identify variation orders, analyse, evaluate, implement and document them. Moreover, these steps would assist to manage variation orders effectively to avoid design errors, delay, cost overruns, quality defects and disputes among public clients and consultants”*

*“I think most of the design consultants want to apply the initiated design changes by the client without any errors to avoid conflicts and disputes; this thing is hardly possible to be achieved, as there is no formalised and agreed approach to manage design changes”*

However, participants suggested some further issues must be taken into consideration before applying a change management system in Saudi construction industry. These suggestions were as follows:

*“In fact, some issues need to be highly considered to apply any variation order management system successfully. These issues are improving the stakeholder engagement, providing workshops and training courses to the project parties to fully understand how change management systems work, having full awareness of the variation orders process, paying more attention to the contract’s terms and improving the communication and co-operation among project teams”.*

## **5.6 Current model of variation order management**

The respondents from both public sector clients and private consulting firms in the exploratory interviews stated that any party involved at the design stage can initiate a variation order that has to be in official written form; however oral form is acceptable in some cases, as well. Furthermore, the respondents declared that there is no formalised approach employed in all public and private sectors to manage variation orders at the design phase in Saudi public construction projects. According to respondents, the Standard Public Works Contract (SPWC) does not pay attention to the method of variation order management. However, most of them follow the basic principles for any variation order management system, from their experience. The conceptual model of the

most likely common practice currently used in managing variation orders in the design phase can be divided into five main stages, as shown in figure 5.4:

- (1) *identifying the variation order*
- (2) *analysing and evaluating the variation order,*
- (3) *estimation and approval,*
- (4) *implementation and*
- (5) *documentation.*

The first stage of the model is *the variation order identification*. Both here, in the first stage, and also during implementation full variation order identification will greatly assist the project team in analysing and evaluating the variation order. The public client or the consultant identifies and initiates a variation order, whether the variation is beneficial or detrimental to the project lifecycle. Identifying and initiating variation orders at early design stages can help the design team to manage variation orders effectively and minimize the negative impact of the variations. Identifying the variation order proposal includes identifying the variation order type, cause and initiator.

The second stage is *analysing and evaluating the variation order*. This step is important for for both public client and consultant, in deciding whether to go ahead with the variation order or to conduct further investigations. The analyses and evaluation criteria of variation order management cover the aspects that affect the design and project performance and also the need for the variation order.

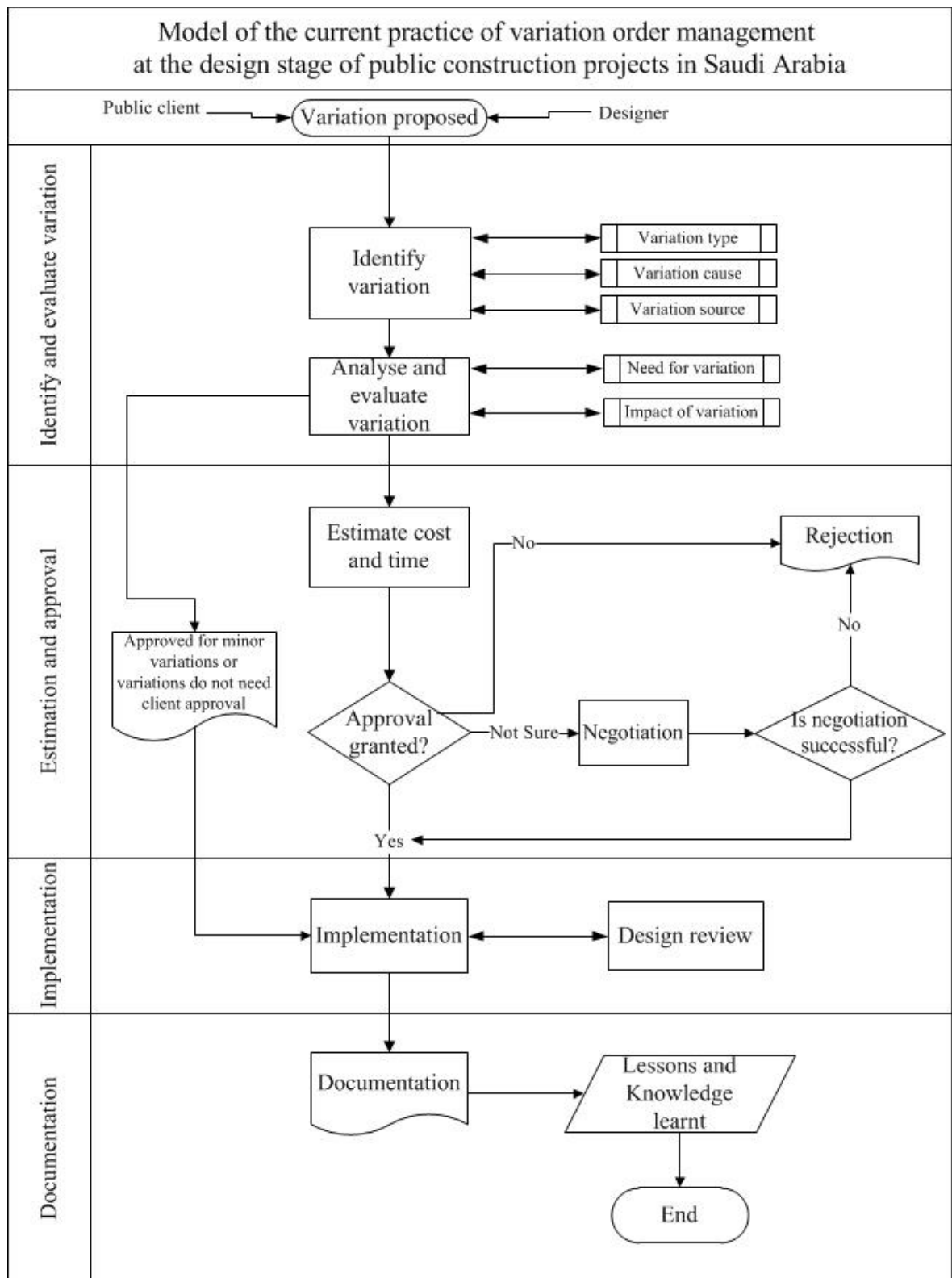
The third stage of the model is *estimation and approval*. In this stage, the consultant estimates the cost and duration of the part of the variation order to be implemented in the design stage and also the cost and duration of the variation to be constructed on the site in the construction stage, in order to get the approval from the public client. In this stage, the public client approval is a significant step, as different outputs are expected. The public client needs to review the potential variation order against the project scope in order to make the decision on the approval. Here, there are three possible types of approval status, which are:

- ‘Yes’ where the public client approves the proposal of the variation order
- ‘No’ where the public client rejects the variation order proposal
- ‘Not sure’ where the public client is not sure about the proposal of the variation order due to its cost or time implementation. The consultant and public client are thus encouraged to review and negotiate the proposed variation to reach a compromise. If the client and consultant do not agree on cost or duration of the variation order proposal, then the variation is rejected. However, when both parties are agreed on the estimated cost and time implementation for the variation order, then the order is approved.

In some cases, for minor variation orders that do not affect the design or the project baseline, the consultant implements these variation orders without getting the approval from the client.

The fourth stage of the current practice is the *implementation* of the variation order, after getting the approval from the public client. Here, most public client and consulting firm respondents stated that good communication skills among project teams would assist in the timely implementation. Furthermore, they believed that design team involvement and co-operation among different disciplines would assist in the design review to avoid the design errors while implementing the design change.

The fifth stage is the *documentation* of the variation order. After the physical implementation of the variation order in the design stage, the variation order should be archived for future construction projects. This stage assists public clients and consultants to learn lessons and build up their knowledge from the implemented variation orders, for future experience.



**Figure 5-4 The current practice of variation order management**

### **5.7 Strengths and weaknesses of the current practice**

All the developed models in variation order management in the construction industry assume that the project parties should have enough knowledge and awareness of change management practices to apply these models efficiently. However, as pointed out earlier, the change management system is relatively new in the Saudi construction industry, and, as revealed in the exploratory interviews, there is a lack of knowledge and awareness of change management practices in the Saudi public construction industry, particularly in the design stage. Furthermore, the need for stakeholder engagement and interaction during the variation order process, in order to manage the process effectively, is not clearly understood either by the public client or the design consultant. Therefore, the strengths and weaknesses of these current practices must be taken into consideration before developing a proposed model for variation order management. This part of the study will enable the researcher to better understand the needs of the variation order management system to be applicable for the Saudi public construction industry. The following strengths and weaknesses in the current Saudi practice were identified, based on the analysis of the exploratory interviews:

#### ***Strengths:***

Apart from the application of the basic principles of variation order management, no clear strengths were revealed from the data collection. However, some other points were considered as strengths, based on what the participants would like to do to improve the current practice.

- Project parties apply the most common practices in variation order management.
- Project parties agree on the need for a variation order management system for the following reasons:
  - Will assist to have a better change management
  - Will help to well identify variation orders
  - Analysing variation orders comprehensively.
  - Avoiding unforeseen design errors caused by variation orders
  - Leading to an effective design and review process

- Highly recommended by both public clients and consultants to develop variation order management system
- Any improvements to the current practice can be implemented due to the project parties applying the basic principles of the variation order management process.

***Weaknesses:***

- Poor co-ordination and communication among the design team in terms of
  - Progress meetings
  - Applying communication technologies
  - Relations between client and consultant
  - Well-timed procedures
  - Bureaucracy among project parties.
- Not having full change details such as
  - Full identification of change
  - Defining the change
  - Aim and need for change
  - Detrimental and beneficial impacts of change.
- Shortage of professional project team members, for instance;
  - Use of inexperienced and unqualified engineers.
  - No up-to-date training courses and workshops in change management.
- Not enough attention to change management practices, for example
  - Awareness of change management systems
  - Understanding the process of variation order management
  - Knowledge of the significance of applying variation orders management systems
  - Assuming it is complicated and costly.
- Considerable lack of well-written down contracts, notably about dealing with variation orders.
- Poor engagement of stakeholders:
  - Lack of interaction between the client and design consultant during the change



- Stakeholders' responsibilities are not well identified in the change process
- Interference by public client affects the process of variation order management.

### **5.8 Differentiation between established models and current practice**

There appears to be no significant differentiation between the internationally established models and the current practice to manage variation orders in the Saudi public construction industry, in terms of the basic management process. This similarity is due to most public clients and consulting firms in Saudi Arabia adopting the basic principles of any variation order management system. However, there is a considerable differentiation in the detailed process and the method of implementing these systems, due to the weaknesses in understanding the importance of implementing these systems correctly. These weaknesses are caused by the poor interaction and engagement of stakeholders in the change process. Furthermore, there is a considerable lack of awareness of the benefits and significance of a variation order management system for the design cost, time and quality.

### **5.9 Integration of stakeholder power-interest level and the Saudi current practice of variation order management**

Stakeholder engagement requires a purpose. It is vital to first think about the reason for engaging the stakeholders and what should be achieved. That means no engagement of stakeholders should be initiated without identifying a purpose. Jergeas *et al.* (2000) believe that many different problems can be avoided when the stakeholders are actively involved in the project process and a systematic approach is applied to identify and manage stakeholders in the project process. As Chinyio and Olomolaiye (2010) state, stakeholders have claims, rights and expectations; they have to be managed in each single project to avoid any of their impacts that could be contrary to a firm's objectives.

There is a lack of understanding and communication of stakeholder engagement during the process of variation order management in the Saudi public construction projects. Moreover, the literature review and previous projects have revealed the clear absence between the linkage of variation order management process and the stakeholder engagement, which negatively influences progress and implementation of variation orders. The researcher thus attempts to raise the awareness of the stakeholders in the

Saudi construction industry regarding the importance of stakeholder engagement during the process of variation order management. This awareness will be achieved by integrating the notions of stakeholder power-interest level and the current practice of variation order management. To Mendelow (1981) *“The stakeholders who possess power relative to the organisation are liable to change due to the impact that the stakeholder environment can have on the stakeholders’ power base”*. Hence, identifying the level of power for each stakeholder and locating them in the power-interest matrix would highly assist in managing variation orders effectively, as this matrix would identify their locations, communication, responsibilities and authority in the variation order management model, to smoothly manage variation orders. (See section 3.4.1).

The reason for choosing the stakeholder power-interest matrix and particularly to integrate it with the current practice of variation order management is that this matrix is the most common technique of mapping stakeholder impact (Johnson and Scholes, 1999). In addition, this matrix is applied when researchers attempt to analyse the influence of stakeholders in a project, as it indicates the type of communication and relationship that the project manager can establish among the stakeholders to manage them effectively (Newcombe, 2003; Bourne and Walker, 2005).

As confirmed in the findings of the exploratory interviews there is no formalised approach to managing variation orders (see section 5.5). This issue could be attributed to the fact that, the absence of effective stakeholder management and engagement decreases the performance of both public client and design team in managing variation orders. Furthermore, the unnecessary public client interactions lead to poor management. These negative interactions take place just because the stakeholders’ responsibilities and communication techniques are not identified and understood in the current variation management process. Hence, identification of the stakeholder responsibilities and relationships, notably in terms of their interest and power level in each step of the variation order management system will assist in better management of variation orders. The stakeholders’ commitment, power and interest should be fully understood by project managers in order to assist them in tackling any problem in the stakeholder management process.

Thus, stakeholder engagement needs to be designed and implemented in a reliable approach in order to realise the benefits of integrating this factor with the current variation order management system. The method of integrating stakeholder engagement and variation order management will be explained in depth in the following chapters.

#### **5.10 Power and interest of stakeholders in the current practice**

The current practice of variation order management in Saudi public construction projects in the design stage applies the basic principles of any established variation order management system, which are *identifying, analysing and evaluating the variation order, estimation and approval, implementation and documentation*. Additionally, most of the Saudi public clients and consulting firms adopt these principles (section 5.6). The conceptual model for the current practice of variation order management in the Saudi public construction projects (see figure 5.5) does not consider the significance of effective stakeholder engagement in the process of the variation order management. Additionally, the existing body of literature does not identify the strengths of the public client or/and design consultant in managing design changes (see section 3.6). However, from the analysis of the exploratory interviews, it can be inferred that the public client is more powerful than the design consultant in the all stages of the current practice of variation order management (refer to section 5.5.2).

The power of the public client commonly influences the success of the variation order implementation, due to the poor level of design consultant engagement, with regards to decision-making. In contrast, the public client gives the consultant a minimal input in managing design changes. Undoubtedly, this low level of design consultant participation and contribution in the process of variation order management leads to poor management, design errors, and conflicts and disputes.

Two points are worth noting in this context: low level of interest does not mean no interest, also low level of power does not mean no power at all. In addition, the level of interest may differ in initiating the variation order, based on the source of the variation order, due to lack of a clear contractual agreement with regard to variation orders. However, the level of interest in managing the variation order shows no differences whether the client or the consultant is the source of the variation order, in the current practice.

This research intends to improve management of variation orders by effectively engaging the public client and design consultant in the process of variation order management practice. Therefore, mapping the integration of variation order management and stakeholder engagement would highly improve the practice of variation order management. The proposed approach will identify the level of power and interest that locate the public client and consultant in the matrix, to provide a better picture of how communication and relationships among stakeholders can be employed effectively. Moreover, determining the responsibilities and roles of the involved stakeholders, to speed up the process and overcome disputes and conflicts between them, is one of the objectives of the primary data collection stage (see section 6.6).

In order to achieve the research aim and objectives, the researcher should understand the level of power and interest for public clients and design consultants in the current practice. This understanding will enable the deficiencies to be determined that have led to the poor management and the current practice and the implications of the best practice model to be compared to contribute the improvement of variation order management (see section 7.4).

Thus, based on the qualitative analysis in section 5.5, the researcher here makes an attempt to analyse the current practice in terms of the level of power and interest for stakeholders in each stage of variation order management. In the current practice, the public client shows a low level of interest during most of the process of the variation order management. The only stages where a high level of interest that can be shown by the public client are in the variation order estimation and approval stages. From the qualitative analysis, this interest can be described as implementing the change order within the design cost and time, regardless of the effectiveness of managing the variation order. Additionally, getting the approval from the client is an essential step to go forward with the variation order implementation.

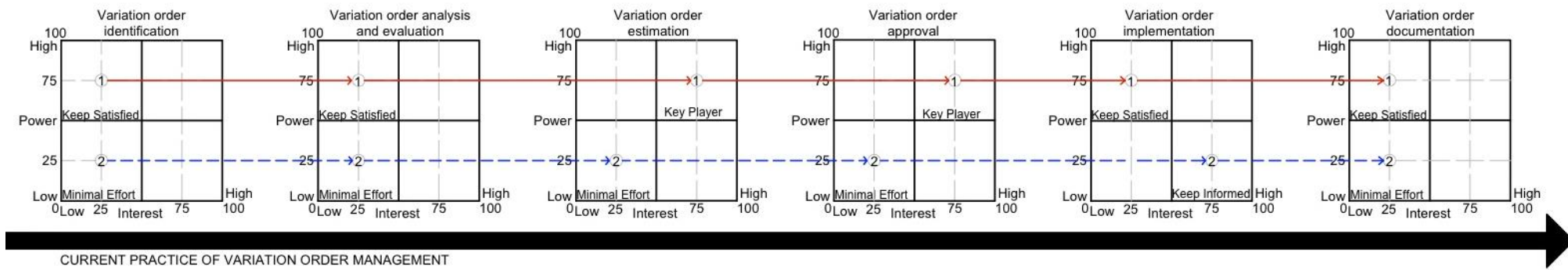
In contrast, the design consultants show a low level of interest in the entire system of the current practice of variation order management. However, the only high interest revealed from the quantitative interviews is in the variation order implementation stage. This high level of interest is due to the fact that the design consultant aims to implement the variation order without any design errors. In this stage, the design consultant intends to avoid any extra-contractual liability due to poor variation order implementation,

which might affect the design progress or even the construction phase. This issue can arise due to the lack of clarity in the variation order identifications by the client. It might also be due to the time limitation given by the public client in the design stage.

In this section, the researcher makes an attempt to develop a model that integrates the current practice of variation order management with the most common technique of stakeholder mapping, which is the power-interest matrix. This attempt intends to investigate how the current practice can be developed for best practice by effectively engaging the stakeholders in the process of variation order management. The analysis shows that the public client has high level of power in the entire process of the current practice. However, apart from the variation order estimation and approval stages, the public client shows low level of interest in the current process of variation order management. This means the consultant makes an effort to keep the public client satisfied with the process of variation order management.

In contrast, the interviews indicate that the public client allows a minimal input to the design consultant in managing design changes. As a result of that, the design consultant shows a low level of power and also a low level of interest in the current practice. However, the public client should keep the design consultant informed about any decision in the implementation stage, as the consultant has high interest in implementing the change effectively.

This level and method of engagement in current practice in the Saudi public construction projects lead to shortcomings in managing variation orders. In order to better manage the current practice, stakeholder mapping will be applied for the whole process of the current practice to come up with best practice of variation order management. This application will be developed on what should happen, based on the stakeholders' thoughts later in chapter 7. Figure 5.5 below shows the conceptual model for location of stakeholders in the power-interest matrix, for the entire process of the current practice of variation order management system.



**Figure 5-5** The locations of public client and design consultant in the developed model of the current practice: 1 represents public client, 2 represents consultant

### 5.11 Causes of ineffective stakeholder engagement in the current practice

This section suggests the causes behind the ineffective engagement among the design consultants and the public clients during the process of variation order management in the Saudi public construction projects, based on the qualitative analysis. In the first stage of the current practice, which is *variation order identification*, there are several causes behind the poor identification of variation orders. These are as follows:

- *Delay in initiating variation orders:* due to the public clients making low effort to identify the variation order and giving the design consultants low interest.
- *Insufficient details of the variation order:* due to the public clients not providing enough information about the change to the design consultant.
- *Lack of accessible information:* this is because of the low interest from both parties in this stage, due to insufficient information.
- *Poor communication:* the above causes lead to poor communication among the involved stakeholders in this stage.

The causes of the inappropriate stakeholders' positions in *the variation order analyses and evaluation* in the current practice can be identified as follows:

- *High number of interactions by the client:* this leads to delay in evaluating the change order, due to the high level of power for the client.
- *Lack of an accessible environment:* this is due to the fact that, public clients do not give the design consultants the opportunity to analyse and evaluate the variation order effectively. Also, the design consultants do not inform the clients about the importance of this stage.
- *Poor co-ordination:* the above causes lead to poor co-ordination between the client and designer in this stage.

The third stage of the current practice of variation order management is *the variation order estimation*. From the exploratory interviews, the following reasons were cited as leading to inaccurate cost and time estimation:

- *Client interference:* interferences in the cost and time estimation by public clients influence this stage negatively.
- *Lack of consultant contribution:* this can be considered as due to the fact that, the public client, as the key player in this stage, does not give an enough attention to the consultant's decisions.

The current practice gives *the variation order approval* stage, high importance for the following reasons:

- *The significance of variation order approval:* this is the stage in which the public client and design consultant make a decision to go forward for the change or reject it.
- *Reviewing the variation order:* in some cases, negotiations may occur in this stage and/ or the public client asks the consultants for further investigations to make a decision for the proposed variation order.

The fifth stage of the current practice of variation order management is *the variation order implementation*. The analysis of the exploratory interviews revealed the following causes that have led to poor variation order implementation:

- *Ineffective environment:* the absence of an effective work environment influences the consultant's ability to implement the variation order efficiently.
- *Lack of follow-up:* This is due to the low level of interest for the public client in this stage.

Finally, the causes of the unsatisfactory stakeholders' positions in *the variation order documentation* in the current practice can be identified as follows:

- *Shortage of data-based knowledge:* this is because the public client does not give the design consultant enough attention to enable the consultant to document and archive the variation order to learn lessons from it for their future projects.



- *Unawareness of the importance of this stage:* this is a significant cause of the high occurrence of variation orders, design errors and the associated problems with variation order management. This issue can be considered as arising because the stakeholders have not learnt from the previous process of managing the variation orders.

## **5.12 Summary**

This chapter has described the methods of data collection and analysis and the findings of the exploratory semi-structured interviews carried out in the Saudi public construction industry during the qualitative approach stage of this research. One of the key findings that emerged from this study is the need to develop an appropriate variation order management system in the Saudi construction industry. Moreover, this chapter has investigated the current practice of change order management, existing models and frameworks and the need for them, as well as the confirmation of the research problem and a report of the participants' suggestions. The current conceptual model was designed by determining the strengths and weaknesses to understand the current practice and to confirm the need for developing a best practice model. Following that, this chapter identified the location of stakeholders during the current process of variation order management and the causes of ineffective stakeholder engagement. Finally, this chapter has attempted to raise awareness of the importance of the integration of stakeholder engagement and variation order management to better manage variation orders in the Saudi construction industry.

## **Chapter 6 - Best practice of variation order management (Quantitative stage)**

### **6.1 Introduction**

This chapter seeks to shed more light and elaborate on a number of the key issues revealed from the qualitative stage of the research (Chapter 5). The aim of this chapter is to design the most appropriate instrument to collect the required data. Thus, a questionnaire survey was designed to understand the level of power and interest of the stakeholders. The questionnaire survey is based on three formulated propositions to enable the research and the subsequent data collection to be focused on the research area. This chapter consists of three main sections: 1) describing the questionnaire design and the criteria that were used in their selection, 2) explaining and justifying the method applied to carry out and analyse the questionnaire survey, and 3) presenting a descriptive and statistical analysis of the results which emerged from the quantitative survey.

In-depth statistical analysis is provided using SPSS statistical software. This analysis assists in strengthening the results and understanding the level of power and interest for stakeholders in the process of variation order management. Furthermore, this chapter verifies the research propositions to confirm the need for a system to better manage variation orders in the Saudi public construction projects and to contribute to its development. Additionally, the findings of the quantitative stage are discussed. A discussion on the analysis of the different results presented in this chapter is carried out, with an attempt made to explain some of the reasons that may be behind these results.

### **6.2 Summary of information from previous qualitative stage and literature review**

The qualitative stage of the research, as discussed in Chapter 5, and the existing body of literature reviewed in Chapters 2 and 3 revealed several findings in relation to the need of a system to manage variation orders effectively. The most significant findings concern the poor stakeholder engagement in the current practice of variation order management in design stage of Saudi public construction projects leading to

shortcomings in managing variation orders (see section 5.7), the summary of the other findings were as follows:

- Stakeholders' responsibilities are not clear enough with regards to the variation order management process.
- Stakeholder engagement is not clearly understood during the variation order management process.
- Interference by public clients during managing and implementing of the variation order affect the process of managing it.
- Poor co-ordination and lack of effective communication among the stakeholders.

Although the Saudi public construction industry adopts the basic principles of any variation order management system, which can be basically described as "*identify variation, analyse variation, evaluate variation, implementation and documentation*", it was clearly noted that the poor engagement between the public client and consulting firm influences the success of the current practice of managing the variation order. Based on the qualitative findings and the literature review of variation order management and stakeholder management in the construction industry many questions have arisen:

- What is the importance of having good stakeholder engagement in the variation order management process?
- How can the stakeholder engagement during the process of variation order management be improved?
- Will the identification of the stakeholders' responsibilities in the process of variation order management assist the design team to better manage the variation order?
- How can the stakeholder mapping, through the power/interest matrix, be integrated with the basic principle of variation order management to improve the current practice?

In an attempt to provide answers to the questions above, it was proposed to undertake some of the remaining research objectives and shed more light on the findings from the exploratory interviews. It was crucial to formulate research propositions to confirm the

purpose of integrating stakeholders to better manage variation orders. Thus, a quantitative study was performed to identify the level of power-interest for stakeholders in the current system. Furthermore, this quantitative method can confirm the generalizability of results from the qualitative interviews to a larger sample size and more statistically representative sample. The combination of qualitative and quantitative methodologies is called mixed methodology or triangulation. Researchers apply this approach to validate the results of one methodology by conducting exact the same study employing another methodology.

The study involved distributing questionnaires to public clients and consultant firms in Saudi public construction projects. The other reasons why it was considered proper to carry out a quantitative study in addition to the qualitative study were:

- Triangulation of data.
- An opportunity to gain more data and expand the results obtained from analysis of qualitative data.
- An opportunity to gain first hand information from public clients and design consultant to understand the stakeholder power-interest level in the variation order management system.
- An opportunity to develop a good practice to better manage variation orders.

### **6.3 Questionnaire Survey**

A questionnaire survey is the second method, after the exploratory interviews to gather data for the purpose of this research. According to Given (2008) *“a questionnaire could be used to confirm the generalizability of results from a small interview study to a larger, more statistically representative sample”*. Traditionally the questionnaire is a form of a printed document and is fundamentally a list of questions. The significant features of the questionnaire are that the design itself is extremely structured and that the same questions are asked to all the respondents in the survey (Miller and Brewer, 2003). A questionnaire survey is one of the most common techniques for collecting data. Compared with other techniques, a questionnaire is inexpensive and can provide a broad geographical area for the research sample. Moreover, the anonymity in questionnaires assists the participants to feel free to write and express their ideas without any concern.

Generally, there are three types of questionnaires, which are (a) a self-completion questionnaire where respondents can answer the questions by themselves, (b) a telephone questionnaire where respondents give their answers over the telephone and (c) a face-to-face questionnaire where the respondents complete the questionnaire with the researcher to provide assistance and explanation to them (Given, 2008).

For the purpose of this research, a self-completion questionnaire method was employed. According to Given (2008) this type of method has several advantages: for example, it is cheaper than other methods; easier to distribute over different cities, as the homeland of the study is a large country; it is convenient for the respondents, as they can complete it at their preferred time and send it back when it is finished and it is simple to complete, as they just need to tick the preferred answers. Also, the anonymity assists the respondents to complete the questionnaire and increases the rate of the responses. Additionally, the absence of the interviewer eliminates the influence of the interviewer. Nevertheless, adopting a self-completion questionnaire method has some drawbacks: sometimes participants do not understand or/and may not be confident about the meaning of the question because they are not familiar with the topic of the questionnaire. In these cases the respondents may not complete the questionnaire or answer it incorrectly and they may even leave some questions without an answer. Furthermore, the respondents are sometimes not interested in the subject of the questionnaire, which may reduce the response rate. The respondents will not answer the questionnaire if it is very long, hence in this research the questionnaire is short but comprehensive. Moreover, the questions are designed to be clear and specific as well as applicable to all participants. One more point must be taken into account: there is no way to ensure that the right person has actually answered the questionnaire (Bryman, 2004; May, 2005).

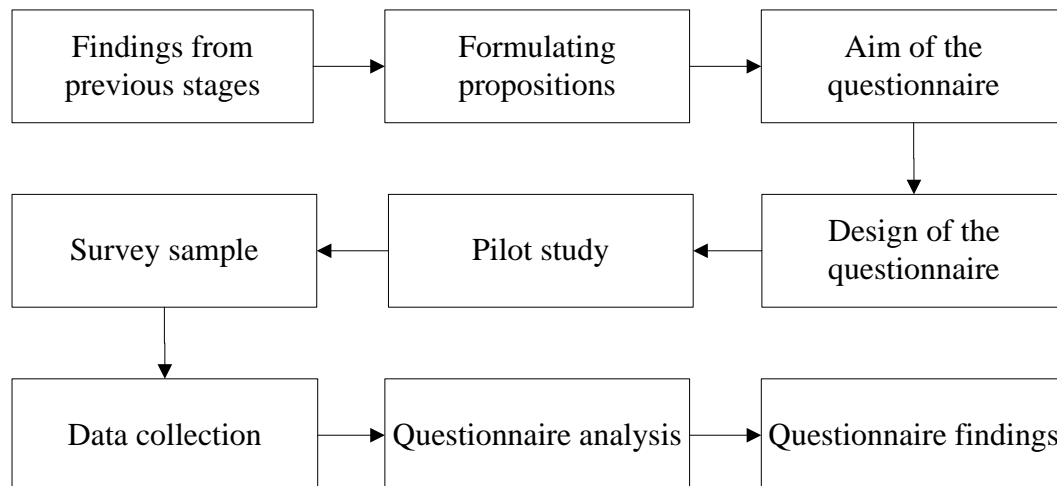
This questionnaire adopts mostly a closed question format to avoid some difficulties that are related to the open-ended question format. According to Kumar (2005) closed-ended questions have some advantages and disadvantages. The advantages are that this question format enables researchers to gain the required data, as the respondents answer specific questions; it also simplifies the questionnaire analysis, as the collected data has already been classified.

The disadvantages of this technique are that the collected data lacks variety and depth; the answers of the respondents may not reflect their opinions, as they select particular

choices, and the findings may reflect the research bias, as the researcher focuses on the results he/she is interested in.

#### 6.4 Questionnaire survey process

In order to achieve the questionnaire survey aim, a framework of the survey process has to be designed and followed. Figure 6.1 clarifies the steps of the questionnaire survey to design a model that integrates the stakeholder power-interest matrix with the current process of variation order management to better manage variation orders. The process starts with summarizing the findings from the existing body of literature in relation to the research area and main findings that emerged from the qualitative stage. Following that, three research propositions were formulated to confirm the purpose of the next stages. Then, the aim and objectives of the questionnaire survey were determined. The next step was designing the questionnaire questions and dividing them into three sections. The following step was to ensure the questionnaire is reliable by performing a pilot study. Then, survey sample and size for both public clients and consultants were identified. After that, a field trip to Saudi Arabia was conducted to collect the research data. Finally, the last two steps were the questionnaire analysis and findings.



**Figure 6-1 The process of the questionnaire survey**

#### 6.5 Research Propositions

The qualitative stage of the study, in addition to a review of the literature, revealed several findings (refer to section 5.5) in relation to the poor engagement of stakeholder during the process of the current practice of variation order management in Saudi public construction projects. The issue of variation order management has received much attention in the literature. In this context, several strategies have been acknowledged as

useful in managing variation orders (e.g. Charoenngam *et al.*, 2003; Chan and Yeong, 1995; Arain and Pheng, 2007; Motawa, 2004). See section 2.12 for more details. In addition, as researchers in the construction industry have realized the importance of stakeholder management in project outcomes, recognition of the concept of stakeholder management has grown (e.g. Newcombe, 2003; El-Gohary *et al.*, 2006; Olander and Landin, 2005). Consequently, the growth of interest in stakeholder management has been expanded in different perspectives of stakeholder research (Friedman and Miles, 2006). This growth has guided some scholars (e.g. Newcombe, 2003; Olander and Landin, 2005; Kolk and Pinkse, 2006; Bourne and Walker, 2006) to propose different approaches that are recognised as beneficial with regards to stakeholder management, as discussed in section 3.5.

However, as pointed out above, in these different models and approaches, the existing models of variation order management and even the proposed approaches of stakeholder management in the construction industry, little or no attention has been paid to the significance of linking these two elements together. Moreover, in the construction research no attempt has been made to identify the stakeholders' key characteristics during the variation order management process.

For these reasons, three propositions were formulated to confirm the purpose of integrating stakeholders with the current practice to better manage variation orders, which would speed up the process and avoid conflicts and disputes. The propositions enabled the research and the subsequent data collection to be focused on the research area. The propositions are as follows:

- Determining an appropriate level of stakeholder engagement throughout each stage in the basic principles of variation order management leads to the greater success of the management of variation orders and can improve the communication and relationships among stakeholders.
- Integration of stakeholder mapping into the current variation order management system will assist the design team to better manage variation orders, by improving the cooperation and determining the responsibilities.

- Applying a system that identifies the level of power and interest for each stakeholder in the process of variation order management would enable them to contribute to the developed system to better manage variation orders, thus assisting in saving time and overcoming the potential conflicts and disputes that may arise during the process of variation order management.

In order to satisfy proposition 1, verification was sought to confirm the significance of having a good stakeholder engagement to better manage variation orders. The verification for proposition 2 was sought to (a) identify the level of power and interest for both public clients and consulting firms and (b) identify the stakeholders' key roles during the variation order management process. The verification for proposition 3 was carried out to confirm that identifying the level of power and interest of stakeholders in the process of variation order management will assist in reducing the time taken to implement the variation and avoid conflicts and disputes. A questionnaire survey was employed to test propositions 1, 2 and 3. Additionally, a focus group workshop was later conducted to test the proposed model based on these propositions.

## **6.6 Aim of the questionnaire**

The results for the qualitative stage (see section 5.7) of the study indicate that the current practices of variation order management in Saudi public construction projects have failed to capture the importance of stakeholder engagement at the design stage. Thus, the researcher makes an attempt to develop a model that improves the management of variation orders by determining stakeholders' responsibilities and authorities and the method of communication and relationship to assist them to engage effectively. This led the researcher to employ a questionnaire survey at this stage, to broadly measure the appropriate level of engagement: explicitly, to improve the current practice, notably in a dynamic industry such as the construction industry, that involves multi-disciplinary activities and teams in each single stage.

Here, the aim of the questionnaire is to understand what stakeholders believe should happen to improve the practice of variation order management by determining the optimum level of power and interest of the stakeholders, in order to develop a model that integrates the stakeholder power-interest matrix with the basic principles of variation order management in the Saudi public construction industry. This integration will assist, firstly in identifying the level of power and interest of the involved



stakeholders (public clients and design consultants); secondly, to locate the involved stakeholders in the power-interest matrix in order to understand their influence And thirdly, to develop a model to improve the current practice to better manage variation orders in Saudi public construction projects by speeding up the process and avoiding disputes and conflicts. The objectives of the study are as follows:

- To verify the selected propositions.
- To identify the significance of having a good stakeholder engagement in order to better manage variation orders.
- To identify the level of power and interest for both public clients and design consultants in each step of the current practice of variation order management explicitly.
- To improve the workflow of variation order management system by speeding up the process.
- To identify the stakeholders' key characteristics during variation order management process and to present them in a way to assist the design team to better manage variation orders.
- To assist the stakeholders to better engage during managing the variation orders.

#### ***6.6.1 Design of the questionnaire***

Based on the comprehensive analysis of the exploratory interviews; in conjunction with the literature review findings, and in the light of the research questions and propositions, the most significant issues related to better management of variation orders at the design stage in the Saudi public construction projects are included in a self-completion questionnaire survey.

The questionnaire is designed to be appropriate for both public clients and consulting firms. Moreover, as this study aims to improve the variation order management in public sectors and consulting firms, the questionnaire asks the respondents to answer the questions based on what should happen. The questionnaire consists of 11 questions and sub-questions. (See Appendix (D) for the questionnaire questions.) In addition, the questionnaire was divided into four main sections, as follows:

- Section one is personal background, which aims to gain information on the general particulars of the participants and their organisations, such as their position in the design process and within the organisation and years of experience. Thus, in order to enrich the survey, it was thought worthwhile to find out the distribution of respondents' positions. Additionally, the years of experience were thought to be important, as it is hoped that participants with more years of experience have faced various cases of variation order management, which would provide a good gauge for improving the practice of variation order management.
- The second section is about the significance of stakeholder engagement during the variation order management process, the identification of stakeholders' responsibilities and the implementation of stakeholder management. This section of the questionnaire aims to substantiate proposition one which is *"Determining an appropriate level of stakeholder engagement throughout each stage in the basic principles of variation order management leads to the greater success of the management of variation orders and can improve the communication and relationships among stakeholders"*.
- The third section concerns the interaction of public clients and consulting firms in the process of variation order management in the current practice, with regard to the level of power and interest for each stakeholder in each step, to identify the level of power and interest for each stakeholder. It is taken into consideration that it is necessary to educate the respondents about the meaning of power and interest in the context of the questionnaire. This section intends to test the second proposition of the research, which is *"Integration of the stakeholder power-interest matrix with the current variation order management system will assist the design team to better manage variation orders by improving cooperation and determining the responsibilities"*.
- The last section seeks to investigate to what extent the participants believe this integration would save time, improve communication and relationships among stakeholders and overcome disputes and conflicts. The fourth section of the questionnaire aimed to confirm the third proposition of the research, which is *"Applying a system that identifies the level of power and interest for each stakeholder in the process of variation order management"*.

*would assist them to contribute to the developed system to better manage variation orders, assist in saving time and overcome the potential conflicts and disputes during the process of variation order management”.* Additionally, the section was intended to explore whether or not there is a need to develop a system to better manage variation orders in the Saudi construction industry.

The second and fourth sections of the questionnaire used a seven point Likert scale. In these sections the respondents express the extent of their agreement by selecting the most appropriate answer as 1= not at all and 7= to a great extent. The third section asked about the level of power and interest for each stakeholder in each step of the current practice of variation order management by ticking the appropriate answer *low or high*. Nevertheless, a few open-ended questions were also asked and there was free space at the end of the questionnaire for those who wished to add further details that they think are related to the better management of variation orders in Saudi public construction projects.

In order to increase the response, the researcher employed some techniques to improve the questionnaire in order to achieve the research objectives. One of these techniques is to ensure the questionnaire is well written and easy for the participants to go through and answer, with an attractive layout and clear instructions to increase the response rate (Dillman, 1983).

The questionnaire included a covering letter introducing the researcher and his school, explaining the aim of the study, assuring confidentiality when dealing with the data obtained from the respondents in the questionnaire, describing the way to answer the questions, providing the contact number and e-mail for the researcher and outlining the ways of returning the completed questionnaire to the researcher.

#### **6.6.2 Pilot study**

It was imperative to ensure that the questionnaire of the main study is reliable. Therefore, the researcher performed a quality control process in order to ensure that the aim and each objective of the survey had questions corresponding to it. The purpose of the pilot study was to examine whether the questionnaire was clear enough to

understand, easy to answer and to examine the design of the questionnaire. Six respondents tested the piloted questionnaire: three of them were Saudi PhD students in construction at different universities in the UK and two from different public sectors and the sixth was from a consulting firm in Saudi Arabia. By getting the respondents' feedback, there was an opportunity to improve the questionnaire.

In order to achieve the purpose of performing the pilot study, the recommended questions for respondents by Bell (1996) were applied:

- *“How long did it take you to complete?”*
- *Were the instructions clear?*
- *Were any of the questions unclear or ambiguous? If so, will you say which and why?*
- *Did you object to answering any of the questions?*
- *In your opinion, has any major topic been omitted?*
- *Was the layout of the questionnaire clear/attractive?*
- *Any comments?”*

Based on the respondents' feedback some amendments to the questionnaire were made and a developed version was designed for the purpose of the main survey. The significant effects of the pilot study were as follows:

- A closer focus on the aim of the questionnaire
- Improving the questionnaire design.
- Decreasing the number of the questionnaire pages from five to four.
- Adding and removing some questions.

### ***6.6.3 Philosophy of selecting the sample***

The research sample of the second and main study was the public sector clients and the consulting firms in Saudi Arabia, as in the first study of the research. The motive behind studying these two parties was to cover the all involved parties in the design stage, as they are only the involved parties in the traditional procurement route, and also to discover if there was any variation between their answers. The public sector clients were the 16 Saudi Ministries that carry out public building projects. The selected

respondents of the public clients were the engineers involved in the design stage, such as architects, structural engineers, quantity surveyors, project managers, design managers and client representatives for construction building projects. The sample population was dependent on the number of engineers in the Saudi public sector. According to the Ministry of Civil Service (2011) there were 5000 engineers working in all public sectors in Saudi Arabia. The sample size of the public sector participants was based on Cochran's (1977) formula for continuous data, as no categorical variable will play a primary role in data analysis (Bartlett *et al.*, 2001).

$$n_0 = \frac{(t)^2 \times (s)^2}{(d)^2} = n_0 = \frac{(1.96)^2 \times (1.167)^2}{(7 \times 0.03)^2} = 118$$

Where  $n_0$  = required return sample size according to Cochran's formula = 118.

Where  $t$  = value for selected alpha level of .025 in each tail = 1.96

Where  $s$  = estimate of standard deviation in the population = 1.167.

Where  $d$  = acceptable margin of error for mean being estimated = (number of points on primary scale  $\times$  acceptable margin of error =  $(7 \times 0.03)$ )

Hence, as the population of engineers in the public sectors is 5000, the required sample size is 118 participants. As the sample size does not exceed 5% of the population ( $5000 \times 0.05 = 250$ ), Cochran's (1977) correction formula should not be used to calculate the final sample size.

On the other hand, the design consultants were certified consulting engineering firms whose details were supplied by the Ministry of Municipal and Rural Affairs in Saudi Arabia. According to MOMRA (2013) there are 286 certified consulting engineering firms that cover most regions of Saudi Arabia. The selected respondents of the consulting firms were the architects, structure engineers, quantity surveyors, project managers, design managers and consultant representatives. The sample population was dependent on the number of engineers from the mentioned disciplines in the Saudi private consulting firms. According to Saudi Council of Engineers (SCE, 2013) there are 12, 550 recognized engineers who work in all engineering firms in Saudi Arabia. The sample size of the consulting firms' participants was based on Cochran's (1977) formula for continuous data:

$$n_0 = \frac{(t)^2 \times (s)^2}{(d)^2} = n_0 = \frac{(1.96)^2 \times (1.167)^2}{(7 \times 0.03)^2} = 118$$

Hence, as the population of engineers in the private consulting firms is 12, 550, the required sample size is 118 participants. As the sample size does not exceed 5% of the population ( $12550 \times 0.05 = 628$ ), Cochran's (1977) correction formula should not be used to calculate the final sample size. That means the sample size for both public clients and consulting firms is  $118 \times 2 = 236$  respondents.

However, the typical response rate in the Saudi construction industry should be determined in order to reach the required sample size and identify how many questionnaires should be distributed. For this reason, a review of the Saudi construction research literature was conducted, as shown in Table 6.1.

**Table 6.1 The response rate in the Saudi construction industry**

Scholar	Paper title	Response rate
Alsedairy (1994)	Management of conflict, public-sector construction in Saudi Arabia	30%
Al-Kharashi, A and Skitmore, M (2009)	Causes of delays in Saudi Arabian public sector construction projects	43%
Assaf, S.A. and Al-Hejji, S (2006)	Causes of delay in large construction projects in Saudi Arabia	40%
AlKahtani, A.S (2000)	Involvement of employees and their personal characteristics in Saudi construction companies	49%
Al-Khalil, M. I. and Al-Ghafly, M. A (1999)	Delay in public utility projects in Saudi Arabia.	41%
Hany <i>et al.</i> , (2012)	Indicators for measuring performance of building construction companies in Kingdom of Saudi Arabia	35%
		Estimated average 40%

As can be clearly seen from the above table, the estimated response rate of published Saudi contraction related research is 40%. Bartlett *et al.*, (2001) state that several researchers criticize the need for over-sampling to make sure that this minimum sample size is achieved and that suggestions on how to secure the minimal sample size are scarce. Here in this research, the minimum sample size is 118 for each stakeholder, which means the number of the distributed questionnaires should be  $118/0.4 = 295$  to achieve the sample size for each stakeholder. So, the total number of questionnaires for both public sectors and consultants is  $295 \times 2 = 590$ .

In fact, the response rate in Saudi construction research seems high comparing with other construction research, internationally. This high response rate in Saudi construction research is due to the fact that most of the researchers (Al Kahtani, 2000; Al-Kharashi, and Skitmore, 2009) distribute their questionnaires by hand, as it is the most efficient method. However, the response rate does not necessarily reflect how precise and reliable the results of the questionnaire are. Therefore, a high response rate does not necessarily:

- obviate non-response bias (Barclay *et al.*, 2002)
- compensate for a weak data analysis or faulty questionnaire (Langer, 2003)
- uarantee high quality responses (DeLeeuw and Hox, 1988)

In contrast, a low response rate does not necessarily:

- affect the validity of the data collected (Templeton *et al.*, 1997)
- translate into response bias (Loges and Jung, 2001)
- mean that the results are biased (Lahaut *et al.*, 2003)
- entail non-response error (Dillman, 1991)

#### **6.6.4 Data collection of the questionnaire survey**

The researcher collected the required data for this second and main stage of data collection by conducting a field trip to Saudi Arabia. The data were obtained through distributing the questionnaires among various construction departments in public sector clients and design consultants in the certified consulting firms to get the feedback and comments to assist the researcher to develop a model to better manage variation orders in Saudi public construction projects at the design stage. The questionnaire survey was distributed by post, accompanied by a prepaid addressed envelope and also by sending e-mails and by hand, to maximize the response rate. Table 6.2 shows the total number of questionnaires sent out, number of responses and percentage response rate for each type of organisation.

#### **6.6.5 Reliability of the questionnaire survey**

The reliability of a scale indicates how free it is from random error. It is expected that in any study there will be a certain amount of errors, which can be categorized as either

random error or measurement error. Litwin (1995) argues that having a larger scale can minimize random error, as statistics can be applied to either reject or accept a null hypothesis. In contrast, measurement error is about the accuracy of the instrument's performance. To test a scale's reliability there are two frequently employed indicators, which are test-retest reliability and internal consistency (Pallant, 2001). The test-retest reliability of a scale is measured by administering it to the same set of respondents at two different points in time, and calculating the correlation between the two results gained to see how stable the responses are. Getting high test-retest correlation indicates a more reliable scale.

The second factor of reliability that can be assessed is internal consistency, which is used in this study. Pallant (2001) defines the internal consistency as "*the degree to which the items that make up the scale are all measuring the same underlying attribute*". Internal consistency can be measured in different ways. The most commonly applied statistic is Cronbach's coefficient alpha. This statistic provides an indication of the average correlation among all of the items that make up the scale. Cronbach's coefficient alpha is used in this study to test the reliability and consistency of the statements in each section of 7-point Likert scale in the questionnaire. Values range from 0 to 1, with higher values indicating greater reliability. Internal consistency values of Cronbach's coefficient alpha between 0.7 and 1 are considered within the range of acceptability and suggest good reliability and consistency (Litwin, 1995).

#### **6.6.6 Survey validity**

In addition to determining the reliability of a survey item or scale, the researcher has to examine the survey's validity, or how well the survey measures what it sets out to measure. After documenting that the scale of the survey is reliable, the researcher has then to ensure that the survey is reliably measuring the truth (Litwin, 1995). In this research, the scale of reliability was measured then the researcher ensured the internal validity of the survey instrument is acceptable (see section 6.8).

From the existing literature there are different classifications of types of validity. According to Litwin (1995) there are several types of validity to assess the performance of a survey instrument, which are *face, content, criterion and construct*. Fellows and Liu (2008) suggest another similar classification of types of validity, described as *construct, internal, statistical and external validities*. Deploying the appropriate type of



validity depends on what the researcher applies on the measuring instruments. Internal validity is applied in the research to observe and measure the effects between the responses of the survey and to identify whether the relationship between responses are significant or not.

#### **6.6.7 Regression Analysis**

Regression analysis is a statistical instrument to investigate the relationships between different variables. Usually, the researcher seeks to find out the causal effect of one variable upon others. More specifically, regression analysis assists to understand how the typical value of the dependent variable changes when any one of the independent variables is varied. Moreover, regression analysis is commonly applied for prediction and forecasting (Sykes, 1993). In this study there is no need to analyse the regression as there is no analysis to investigate the causal effect of one variable upon others, also the analysis of this study is not based on prediction and forecasting.

#### **6.7 Questionnaire responses**

This section presents the basic analysis of the number of questionnaires issued and returned, proportion of respondents, respondents' positions and experience. As discussed previously in section 6.3.3, the questionnaire was sent out to 295 individual participants in private consulting firms and also to 295 individual participants in public sectors, with total of 590 participants. The targeted sample in each category was 118 with an estimated response rate of 40%. In total, the number of respondents from both groups of stakeholders was 217 out of 590, with a response rate of 37%. These responses were completed adequately for inclusion within the study. However, there were some questionnaires where respondents did not adequately complete the survey, such as where there were missing answers. Furthermore, some questionnaires were excluded from the study, such as any respondent who had not been involved in designing public construction projects, as this study was designed for those who have experience in designing public construction projects in Saudi Arabia.

The number of respondents from consulting firms was 130 with a response rate of 44%. In contrast, the response rate of public sector stakeholders was only 30%, which means the total number of respondents was 87. This disparity in quantity of responses between the public sector and consulting firms relates to the bureaucracy and lack of knowledge about the importance of research in public sectors. Moreover, the difficulties in

following up with some public sector respondents, due to lack of communication, were another cause of the disparity in quantity of the responses. Table 6.2 shows the total number of questionnaires sent out, number of responses and percentage of response rate for each type of organisation.

**Table 6.2 Summary of number and percentage of responses**

Organisation	Questionnaires issued	Number of responses	% returned
Public sector	295	87	% 30
Consulting firm	295	130	% 44
Total	590	217	% 37

### **6.7.1 Relative proportions of participants**

Table 6.3 illustrates the relative proportions of participants for both types of stakeholders in the public sector bodies and consulting firms in the survey. The total number of respondents participating in the survey was 217. 87 of them are from public sector, 40.1% of the sample. In contrast, the respondents from consulting firms were 130, or 59.9% of the sample.

**Table 6.3 Relative proportion of respondents**

Organisation	Number	% of sample
Public sector	87	40.1
Consulting firm	130	59.9
Total	217	100.0

### **6.7.2 Respondents' positions**

The construction industry is diverse and consists of various different positions. This survey deals with individuals rather than organisations, due to the limited number of public sector bodies. Thus, in order to maximise the number of respondents to enrich the survey, it was thought worthwhile to find out the distribution of respondents' positions. Respondents were asked to indicate the positions they typically hold in their organisations. Respondents were offered six choices to indicate their positions. As can be seen from the Table 6.4 the respondents held a variety of positions in the construction industry. The number of project managers participating in the survey was

75 (34.6% of the sample), 17 design managers (7.8%), 32 architects (14.7%), 24 civil engineers (11.1%) and 15 respondents were site engineers (6.9%). 54 respondents (24.9%) held other positions in the construction industry.

**Table 6.4 The positions of respondents**

Position	Frequency	%
Project manager	75	34.6
Design manager	17	7.8
Architect	32	14.7
Civil engineer	24	11.1
Site engineer	15	6.9
Other	54	24.9
Total	217	100.0

### **6.7.3 Experience of respondents**

From the analysis, the results in Table 6.5 below show different levels of experience among participants, for example 32 (14.7%) of the participants have between 0 and 5 years experience, 44 (20.3%) of the respondents have been working in construction industry for 6 to 10 years, 57 (26.3%) with 11 to 15 years of experience, 20 (9.2%) of the participants have between 16 and 20 years of experience and the highest number of participants involved in this survey, 29.5%, had more than 20 years of experience. This shows that a majority of the participants have a significant number of years in the construction industry; the importance of these is that it is hoped the participants have faced various cases of variation order management, which would provide a good gauge for better practice of variation order management.

**Table 6.5 Years of experience for participants**

Years of Experience	Number	% of sample
0-5	32	14.7
6-10	44	20.3
11-15	57	26.3
16-20	20	9.2
More than 20	64	29.5
Total	217	100.0

## 6.8 Measures of Reliability, Internal Consistency and Validity

After collecting the data from the participants, the data was tested for internal consistency (see Table 6.6). The Alpha coefficient ranges in value from 0 to 1, the higher the scores the higher the internal consistency. Cronbach's Alpha coefficient is commonly used to evaluate the reliability of the scale for the considered factors. Internal consistency values of coefficient alpha between 0.7 and 1 are considered within the range of acceptability and suggest good consistency and reliability (Litwin, 1995) as explained in section 6.6.5.

From the analysis of the Likert scale questions, the Cronbach's Alpha coefficient was calculated to investigate whether the data collected is reliable or not. The total value of the Likert scale questions is 0.863, which signifies that the data received is indicative of internal consistency and therefore suggests the data are reliable. Moreover, the Cronbach's Alpha coefficient indicates the accuracy of the collected data to represent the truth about what the data is asked to prove, and also means the instruments applied for data collection have been well conducted. These particular types of analyses were carried out to guarantee there were no violations of the assumptions of normality.

**Table 6.6 Reliability of the main factors**

Factors	Number of Statements	Cronbach's Alpha
Q6) The significance of stakeholder engagement in the variation order management	9	0.859
Q7) The significance of stakeholder engagement in the process of variation order management	5	0.582
Q10) Effectiveness of integrating stakeholder power- interest matrix with the current variation order management	5	0.783
<b>Total</b>	19	0.863

The analysis for reliability for the first Likert scale questions (Q6), that seek to measure the significance of stakeholder engagement in variation order management determined the Cronbach's Alpha coefficient value as 0.859, for nine statements, which is indicative of the suitability of the instruments and data for evaluation.

The analysis of reliability for the second section of Likert scale questions (Q7), that seeks to measure the significance of stakeholder engagement in the process of variation order management determined the Cronbach's Alpha coefficient value as 0.582 for five

statements, which can be deemed as indicative of internal consistency, as the value of 0.582 is closer to 1 than 0.

The analysis of reliability for the third set of Likert scale statements (Q10), which aims to gauge the effectiveness of integrating the stakeholder power-interest matrix with the current variation order management determined the Cronbach's Alpha coefficient value to be 0.783 for five statements, which is indicative of the suitability of the instruments and data for evaluation.

Statistically, it is assumed that in order to calculate Cronbach's Alpha properly, the researcher should test the Cronbach's Alpha value for all statements then calculate Cronbach's Alpha if each item is deleted. After deleting the item (statement), if the calculated Cronbach's Alpha is more than the value of Cronbach's Alpha for all statements, this means that the reliability has increased and therefore this statement should be deleted. However, if the calculated Alpha is less than Alpha for all statements, this means that the reliability decreased; therefore, this statement should be retained (Gliem and Gliem, 2003). This method was conducted in this study for each statement, to further ensure that the reliability and internal consistency are accurate for the data collected (see Tables 6.7, 6.8 and 6.9).

Additionally, the validity of the responses was tested for the Likert scale questions, to make sure there is a significant correlation among the responses and statements of each section of the survey. The descriptive analysis indicates that the correlation is significant at the 0.01 level, which also indicates the validity of items.

Table 6.7 below shows the correlation between each statement (item) and total to test the validity for the first Likert scale questions, that seek to measure the significance of stakeholder engagement in the variation order management. The results indicate that the correlation is significant which signifies the validity of these items.

**Table 6.7 Correlation and internal consistency for question 6**

Statements for question (6)	Correlation between item and total •	Cronbach's Alpha if Item Deleted
a) Having a good relationship between the public client and the consulting firm to manage variation orders.	0.546**	0.849
b) Establishing an effective communication between the public client and the consulting firm to manage variation orders.	0.561**	0.846
c) Poor co-ordination between public client and consulting firm negatively affects the performance of variation order management.	0.516**	0.852
d) Understanding of stakeholder engagement helps for better management of variation order process.	0.626**	0.841
e) Identification of the stakeholders' responsibilities assists the design team to better manage the variation order	0.603**	0.842
f) Poor implementation of stakeholder management can negatively affect the performance of variation order management	0.588**	0.844
g) Engaging the stakeholders in the change process	0.567**	0.846
h) All stakeholders should know their own tasks and roles in the change process	0.672**	0.837
i) The stakeholder commitment is important to manage variation orders	0.637**	0.839
<b>Total</b>		0.859

• Measures the internal validity. \*\* The Correlation is significant at 0.01 level.

The analysis of responses' validity and level of correlation for the second section of the Likert scale questions (Q7), which seeks to measure the significance of stakeholder engagement in the process of variation order management, showed a significant correlation, which indicates the validity of items. (See Table 6.8).

**Table 6.8 Correlation and internal consistency for question 7**

Statements for question 7	Correlation between item and total •	Cronbach's Alpha if Item Deleted
a) Interaction among stakeholders assists the design team to better manage the variation order.	0.389**	0.518
b) Stakeholder engagement depends on the size and cost of the variation order	0.349**	0.522
c) The client and designer should meet to manage every design change.	0.346**	0.524
d) Personalities and ethics of clients and consultants influence decision making in the design changing process.	0.394**	0.496
e) Cultural diversity between public client and consulting firm negatively influences the performance of variation order management	0.267**	0.577
Total		0.582

• Measures the internal validity. \*\* The Correlation is significant at 0.01 level.

Moving to the third section of Likert scale questions (Q10), the analysis of the responses' validity and level of correlation is presented in Table 6.9. This section aims to assess the effectiveness of integrating the stakeholder power-interest matrix with the current practice of variation order management. The emergent analysis for this section signifies that there is a significant correlation, which indicates the validity of these items.

**Table 6.9 Correlation and internal consistency for question 10**

Statements for question 10	Correlation between item and total •	Cronbach's Alpha if item deleted
a) Not having a system to manage variation orders would increase the duration to implement the variation order.	0.453**	0.777
b) Not having a system to manage variation orders would lead to conflicts and disputes among stakeholders.	0.489**	0.769
c) Involving the stakeholders by identifying the level of power and interest for each one in a variation order management system would assist to speed up the process of implementing the variation order	0.656**	0.710
d) Identifying the level of power and interest for each stakeholder in a variation order management system would assist to avoid conflicts and disputes in the process of implementing the variation order	0.631**	0.718
e) Developing a model that integrates the level of power and interest with the basic principles of variation order management would better manage variation orders	0.587**	0.737
Total		0.783

• Measures the internal validity. \*\* The Correlation is significant at 0.01 level.

## 6.9 Descriptive statistics for questions in the form of the Likert scale

As questions number 6, 7, 9 and 10 were in the form of a 7-point Likert scale, mean and weighted mean for responses need to be calculated. This calculation gives each response a specific weight reflecting its importance. Thus, each statement in the responses takes a weight, as shown in Table 6.10.

**Table 6.10 Weight of responses**

Response	Weight
<i>not at all and</i>	1
2	2
3	3
4	4
5	5
6	6
<i>great extent</i>	7

Moreover, the weighted mean for each statement was calculated in this survey. This calculation can be seen in Table 6.11. This procedure determines which classification of importance the statement belongs to (Fisher, 1935).

**Table 6.11 The weighted mean**

Weighted Mean	Response
From 1.00 to less than 1.86	<i>not at all and</i>
From 1.86 to less than 2.71	2
From 2.71 to less than 3.57	3
From 3.57 to less than 4.43	4
From 4.43 to less than 5.29	5
From 5.29 to less than 6.14	6
From 6.14 to less than 7.00	<i>great extent</i>

### 6.9.1 The frequency distribution and the weighted mean

The frequency distribution was determined for Likert scale questions (Q 6, 7, 9 and 10) to present a summarized grouping of data divided into 7 scales; also the weighted mean was assessed to identify the average scale of responses, the standard deviation, to



demonstrate how much variation or dispersion exists from the average mean and the priority was identified to prioritise the statements.

#### ***6.9.1.1 The frequency distribution of question 6***

Table 6.12 below explains the frequency distribution, the weighted mean and standard deviation, for all the statements in question 6, which seeks to measure the significance of stakeholder engagement in variation order management.

**Table 6.12 Weighted mean, Std. Deviation and priority for Q6**

Statements for question 6	1		2		3		4		5		6		7		Weighted mean	Std. deviation	Overall response in Mean	Priority
	f	%	f	%	f	%	f	%	f	%	f	%	f	%				
a) Having a good relationship between the public client and the consulting firm to manage variation orders.	5	2.3	7	3.2	6	2.8	20	9.2	37	17.1	40	18.4	102	47.0	5.79	1.52	6	8
b) Establishing an effective communication between the public client and the consulting firm to manage variation orders.	3	1.4	4	1.8	6	2.8	13	6.0	33	15.2	51	23.5	107	49.3	6.00	1.34	6	5
c) Poor co-ordination between public client and consulting firm negatively affects the performance of variation order management.	8	3.7	4	1.8	4	1.8	13	6.0	28	12.9	46	21.2	114	52.5	5.96	1.51	6	6
d) Understanding of stakeholder engagement helps for better management of variation order process.	1	0.5	2	0.9	2	0.9	15	6.9	28	12.9	52	24.0	117	53.9	6.18	1.12	<i>great extent</i>	2
e) Identification of the stakeholders' responsibilities assists the design team to better manage the variation order	3	1.4	4	1.8	1	0.5	14	6.5	29	13.4	51	23.5	115	53.0	6.11	1.26	6	4
f) Poor implementation of stakeholder management can negatively affect the performance of variation order management	5	2.3	2	0.9	3	1.4	20	9.2	32	14.7	64	29.5	91	41.9	5.89	1.33	6	7
g) Engaging the stakeholders in the change process.	5	2.3	3	1.4	8	3.7	29	13.4	38	17.5	50	23.0	84	38.7	5.66	1.46	6	9
h) All stakeholders should know their own tasks and roles in the change process	4	1.8	1	0.5	2	0.9	7	3.2	28	12.9	62	28.6	113	52.1	6.19	1.17	<i>great extent</i>	1
i) The stakeholder commitment is important to manage variation orders	4	1.8	4	1.8	5	2.3	6	2.8	24	11.1	53	24.4	121	55.8	6.16	1.31	<i>great extent</i>	3
Total	38	2	31	2	37	2	137	7	277	14	469	24	964	49	5.99	1.35	6	

From the above table (6.12) it can be clearly seen that the total overall response (in Mean) is 6, which indicates that respondents believed there is a significant need to engage stakeholders properly to better manage variation orders in the design stage in Saudi public construction projects. Also, as it can be noted the highest weighted mean and priority (1) in this question is statement (h), which is “*All stakeholders should know their own tasks and roles in the change process*”. A further finding worth noting is that there were three statements on which the respondents agreed to a great extent, which are statements (d),(h) and (i).

#### **6.9.1.2 The frequency distribution of question 7**

Table 6.13 shows the frequency distribution, the weighted mean and standard deviation for all statements in question 7 in the questionnaire survey that asks respondents to assess the significance of stakeholder engagement in the process of variation order management.

It can be clearly observed from this table that the total overall response (in Mean) is also 6, which signifies that respondents believe there is a significant need to engage the involved stakeholders during the process of variation orders to better manage them and avoid any expected problems or mistakes. Moreover, the analysis reveals that the highest priority and weighted mean was for statement (a) that seeks to investigate the importance of interaction among stakeholders to better manage the process of variation orders.

**Table 6.13 Weighted mean, Std. Deviation and priority for Q7**

Statements for question 7	<b>1</b>		<b>2</b>		<b>3</b>		<b>4</b>		<b>5</b>		<b>6</b>		<b>7</b>		Weighted Mean	Std. Deviation	Overall Response (in Mean)	Priority
	<b>F</b>	<b>%</b>	<b>f</b>	<b>%</b>	<b>f</b>	<b>%</b>	<b>f</b>	<b>%</b>	<b>F</b>	<b>%</b>	<b>f</b>	<b>%</b>	<b>f</b>	<b>%</b>				
b) Interaction among stakeholders assists the design team to better manage the variation order.	3	1.4	3	1.4	2	0.9	9	4.1	26	12.0	60	27.6	114	52.5	6.17	1.20	<i>great extent</i>	<b>1</b>
c) Stakeholder engagement depends on the size and cost of the variation order	13	6.0	14	6.5	7	3.2	31	14.3	41	18.9	45	20.7	66	30.4	5.18	1.79	5	<b>4</b>
d) The client and designer should meet to manage every design change.	7	3.2	10	4.6	9	4.1	18	8.3	18	8.3	43	19.8	112	51.6	5.80	1.68	6	<b>2</b>
e) Personalities and ethics of clients and consultants influence decision making in the design changing process.	11	5.1	3	1.4	10	4.6	22	10.1	31	14.3	47	21.7	93	42.9	5.64	1.66	6	<b>3</b>
f) Cultural diversity between public client and consulting firm negatively influences the performance of variation order management	18	8.3	12	5.5	22	10.1	31	14.3	31	14.3	36	16.6	67	30.9	4.94	1.95	5	<b>5</b>
Total	52	5	42	4	50	5	111	10	147	14	231	21	452	42	5.54	1.73	6	

The statements in the above tables (6.12 and 6.13) were designed to substantiate and confirm proposition one of the research, which is “*Determining an appropriate level of stakeholder engagement throughout each stage in the basic principles of variation order management leads to the greater success of the management of variation orders and can improve the communication and relationships among stakeholders*”. The results that emerged from the descriptive analysis strongly indicate that there is a significance in determining the level of stakeholder engagement in the current practice to better manage variation orders in the Saudi public construction projects.

#### **6.9.1.3 The frequency distribution of question 9**

Table 6.14 shows the frequency distribution, the weighted mean and standard deviation for one statement in question 9 in the questionnaire survey, which seeks to examine to what extent the integration of the level of power and interest assist stakeholders to better manage variation orders. For this statement the overall response (in Mean) is 6. This result indicates that, the respondents strongly agree that integrating the power-interest matrix will assist public clients and consulting firms to better manage variation orders. Hence, this result verifies the second proposition of the research, which is “*Integration of stakeholder power-interest matrix with the current variation order management system will assist the design team to better manage variation orders*”.

#### **6.9.1.4 The frequency distribution of question 10**

The last table (6.15) in this section presents the frequency distribution, the weighted mean, standard deviation for all statements in question 10 that intends to measure the effectiveness of integrating stakeholder power-interest matrix with the current practice of variation order management.

From Table 6.15 it can be clearly seen that the total overall response (in Mean) is *to great extent*, indicating that there is a great significance attached to developing a model that integrates a stakeholder power-interest matrix with the current practice of variation order management to better manage variation orders. Also, as it can be seen that the highest weighted mean and priority (1) in this question is for statement (e), which is “*Developing a model that integrates the level of power and interest with the basic principles of variation order management would better manage variation orders*”. Therefore, this result substantiates the third proposition of the research, which is “*Applying a system that identifies the level of power and interest for each stakeholder*”.

*in the process of variation order management would assist them to contribute to the developed system to better manage variation orders, assist in saving time and overcome the potential conflicts and disputes during the process of variation order management ”.* Another finding worth noting in this section is that there were three statements in which the respondents agreed to great extent, which are statements *a, b and e.*

**Table 6.14 Weighted mean, Std. Deviation and priority for Q9**

Statements for question 9	1		2		3		4		5		6		7		Weighted Mean	Std. Deviation	Overall Response (in Mean)
	f	%	F	%	f	%	F	%	f	%	f	%	f	%			
The integration of the level of power and interest assist to better manage variation orders.	1	0.5	4	1.8	4	1.8	17	7.8	38	17.5	59	27.2	94	43.3	<b>5.95</b>	<b>1.23</b>	<b>6</b>

**Table 6.14 Weighted mean, Std. Deviation and priority for Q10**

Statements for question 10	1		2		3		4		5		6		7		Weighted Mean	Std. Deviation	Overall Response (in Mean)	Priority
	f	%	f	%	F	%	f	%	f	%	f	%	f	%				
a) Not having a system to manage variation orders would increase the duration for implementation.	2	0.9	3	1.4	6	2.8	7	3.2	24	11.1	41	18.9	134	61.8	6.26	1.22	<i>great extent</i>	<b>2</b>
b) Not having a system to manage variation orders would lead to conflicts and disputes.	3	1.4	4	1.8	5	2.3	14	6.5	24	11.1	30	13.8	137	63.1	6.18	1.35	<i>great extent</i>	<b>3</b>
c) Involving the stakeholders by identifying the level of power and interest for each one in a variation order management system would assist to have a good communication and speed up the process of implementing the variation order	4	1.8	2	.9	4	1.8	8	3.7	38	17.5	57	26.3	104	47.9	6.05	1.26	<b>6</b>	<b>5</b>
d) Identifying the level of power and interest for each stakeholder in a variation order management system would assist to avoid conflicts and disputes in the process of implementing the variation order	3	1.4	4	1.8	3	1.4	13	6.0	23	10.6	57	26.3	114	52.5	6.12	1.28	<b>6</b>	<b>4</b>
e) Developing a model that integrates the level of power and interest with the basic principles of variation order management would better manage variation orders	2	0.9	1	.5	2	0.9	11	5.1	19	8.8	52	24.0	130	59.9	6.32	1.09	<i>great extent</i>	<b>1</b>
<b>Total</b>	14	1	14	1	20	2	53	5	128	12	237	22	619	57	6.18	1.24	<i>great extent</i>	

### **6.10 The effect of the general variables (t-test)**

In this section the effect of the general variables on the opinions of the respondents will be tested in order to investigate whether there is a significant difference between variables (public sector and consulting firms) or not. This method of statistical test is called a t-test. The t-test is a parametric test used to determine if the mean of a sample is similar to the mean of the population (Fellows and Liu, 2008). Therefore, this section examines the Likert scale questions (Q 6, 7, 9 and 10).

In point of fact, using the t-test to test whether there is a significant difference between means of responses of two independent populations is an important issue (see Table 6.16). To do so, a hypothesis was formulated to test whether there is a significant difference between responses according to their different organisations (public sector or consulting firm). The hypothesis is as follows:

- The null Hypothesis  $H_0$ : The means of responses of two independent populations are equal. In other words, there is no significant difference between the two means of the responses.
- The alternative Hypothesis  $H_1$ : The means of responses of two independent populations are unequal. In other words, there is a significant difference between the two means of the responses.

To verify the hypothesis the t-statistic and the p-value (the level of significance) must be calculated, if the p-value is less than or equal  $\alpha=0.05$ , that indicates the  $H_0$  is rejected and  $H_1$  is accepted, which signifies that there is a significant difference between the two means of the responses. In contrast, if the p-value is more than  $\alpha=0.05$ , that indicates the  $H_0$  is accepted and  $H_1$  is rejected. This confirms that there is no significant difference between the two means of the responses.



**Table 6.15 The t-test and p-value of the responses**

Factors	Organisation	N	Mean	Std. Deviation	*t <sub>215</sub>	Sig. p-value	Conclusion
Q6) the significance of stakeholder engagement in the variation order management	Public sector	87	5.90	0.94	-1.259	0.210	Not Sig.
	Consulting firm	130	6.06	0.91			
Q7) the significance of stakeholder engagement in the process of variation order management	Public sector	87	5.58	1.05	0.417	0.677	Not Sig.
	Consulting firm	130	5.52	1.01			
Q9) the integration of the level power and interest with the current practice will assist to better manage variation orders	Public sector	87	6.14	0.96	-0.571	0.568	Not Sig.
	Consulting firm	130	6.21	0.88			
Q10) Effectiveness of integrating stakeholder power-interest matrix with the current variation order management	Public sector	87	5.85	1.28	-0.971	0.333	Not Sig.
	Consulting firm	130	6.02	1.19			

\* t<sub>215</sub> is the value of the t- statistic at (215) degree of freedom

The above table shows that the p-value (the level of significance) is more than 0.05 for all factors, which indicates that there is no significant difference between the individual responses due to their different organisations. This result confirms that the H<sub>0</sub> is accepted and H<sub>1</sub> is rejected.

### 6.11 F-test (Analysis of Variance ANOVA)

The F-test Analysis of variance (ANOVA test) is a statistical method used to test whether there is a significant difference between means of responses of more than two independent populations (Fellows and Liu, 2008). In this case, this section examines the Likert scale questions (Q 6, 7, 9 and 10) by formulating a hypothesis to investigate whether there is a significant difference between responses according to the position and experience of respondents in both different organisations. The formulated hypothesis is as follows

- The null Hypothesis H<sub>0</sub>: The means of responses of (position/experience) independent populations are equal. In other words, there is no significant difference between the means of the responses according to the position or experience.

- The alternative Hypothesis  $H_1$ : The means of responses of (position/experience) independent populations are unequal. In other words, there is a significant difference between means of the responses according to the position or experience.

To substantiate the hypothesis the f-statistic and the p-value (the level of significance) must be calculated: if the p-value is less than or equal  $\alpha=0.05$ , this indicates the  $H_0$  is rejected and  $H_1$  is accepted, which signifies that there is a significant difference between means of the responses according to their positions or experience. In contrast, if the p-value is more than  $\alpha=0.05$ , that indicates the  $H_0$  is accepted and  $H_1$  is rejected. This would confirm that there is no significant difference between means of the responses according to the position or experience. Tables 6.17 and b.18 shows the f-test and p-value for the responses based on their positions level of experience, respectively.

**Table 6.16 f-test and p-value of the responses based on their positions**

Factors	Position	N	Mean	Std. Deviation	*F <sub>5,211</sub>	Sig. p-value	Conclusion
Q6) the significance of stakeholder engagement in the variation order management	Project manager	75	6.01	0.84	0.845	0.519	Not Sig.
	Design manager	17	6.20	0.81			
	Architect	32	6.17	0.87			
	Civil engineer	24	5.85	1.06			
	Site engineer	15	5.70	0.84			
	Other	54	5.95	1.04			
Q7) the significance of stakeholder engagement in the process of variation order management	Project manager	75	5.51	0.99	0.651	0.661	Not Sig.
	Design manager	17	5.51	0.91			
	Architect	32	5.77	1.01			
	Civil engineer	24	5.28	1.30			
	Site engineer	15	5.60	0.73			
	Other	54	5.57	1.06			
Q9) the integration of the level of power and interest with the current practice will assist to better manage variation orders	Project manager	75	6.29	0.80	1.119	0.351	Not Sig.
	Design manager	17	6.21	1.05			
	Architect	32	6.31	0.74			
	Civil engineer	24	5.83	1.13			
	Site engineer	15	6.12	0.93			
	Other	54	6.12	0.98			
Q10) Effectiveness of integrating stakeholder power-interest matrix with the current variation order management	Project manager	75	6.05	1.26	1.098	0.362	Not Sig.
	Design manager	17	5.88	1.27			
	Architect	32	5.53	1.11			
	Civil engineer	24	5.96	1.40			
	Site engineer	15	5.80	1.01			
	Other	54	6.11	1.19			

\* F<sub>5,211</sub> is the value of the F- statistic at (5,211) degrees of freedom

The above table demonstrates that the p-value (the level of significance) is more than 0.05 for all factors, which indicates that there is no significant difference between the

respondents' opinions due to their different positions in the construction industry. This result confirms that the  $H_0$  is accepted and  $H_1$  is rejected.

**Table 6.17 f-test and p-value of the responses based on their level of experience**

Factors	Experience	N	Mean	Std. Deviation	*F <sub>4,212</sub>	Sig. p-value	Conclusion
Q6) the significance of stakeholder engagement in the variation order management	(0-5)	32	6.00	0.70	0.393	0.814	Not Sig.
	(6-10)	44	6.01	0.71			
	(11-15)	57	5.88	0.98			
	(16-20)	20	6.16	1.32			
	More than 20	64	6.03	0.95			
Q7) the significance of stakeholder engagement in the process of variation order management	(0-5)	32	5.48	1.00	0.351	0.843	Not Sig.
	(6-10)	44	5.66	0.79			
	(11-15)	57	5.46	1.04			
	(16-20)	20	5.68	1.20			
	More than 20	64	5.53	1.12			
Q9) the integration of the level of power and interest with the current practice will assist to better manage variation orders	(0-5)	32	6.28	0.69	1.935	0.106	Not Sig.
	(6-10)	44	6.10	0.82			
	(11-15)	57	6.02	1.00			
	(16-20)	20	6.64	0.57			
	More than 20	64	6.19	1.03			
Q10) Effectiveness of integrating stakeholder power-interest matrix with the current variation order management	(0-5)	32	5.81	1.23	0.208	0.934	Not Sig.
	(6-10)	44	5.89	1.28			
	(11-15)	57	6.04	1.07			
	(16-20)	20	6.00	1.30			
	More than 20	64	5.97	1.32			

\* F<sub>4,212</sub> is the value of the F- statistic at (4,212) degrees of freedom

The above table illustrates that the p-value (the level of significance) is more than 0.05 for all different factors, which signifies that there is no significant difference between the respondents' opinions due to their different level of experiences in the construction industry. This result confirms that the  $H_0$  is accepted and  $H_1$  is rejected

## **6.12 Level of power and interest for stakeholders for best practice of variation order management**

This section of the quantitative analysis presents the frequency distribution of the participants' opinions regarding what should be the level of power and interest for public client and consulting firm. This question identifies the scale of the power and interest in each principle of the variation order management process during the design stage. Table 6.19 below shows the frequency and percentage of participants' opinions on the level of power and interest in the process of variation order management for both public clients and consulting firms. Further details will be discussed in the next chapter by locating these results in the power-interest matrix to identify the position of each stakeholder during the process of managing variation orders at the design stage in the Saudi construction industry.

**Table 6.18 Frequency and percentage of power and interest levels**

Principle	Public client								Consulting firm							
	Power				Interest				Power				Interest			
	Low		High		Low		High		Low		High		Low		High	
	f	%	f	%	F	%	f	%	f	%	f	%	f	%	f	%
<b>1- Identify variation</b>	59	27.2	158	72.8	141	65.0	76	35.0	169	73.7	57	26.3	53	24.4	164	75.6
<b>2- Analyse and evaluate variation</b>	130	59.9	87	40.1	90	41.5	127	58.5	45	20.7	172	79.3	161	74.2	56	25.8
<b>3- Estimate cost and time</b>	66	30.4	151	69.6	134	61.8	83	38.2	56	25.8	161	74.2	60	27.6	157	72.4
<b>4- Approval</b>	60	27.6	157	72.4	82	37.8	135	62.2	116	53.5	101	46.5	151	69.6	66	30.4
<b>5- Implementation</b>	123	56.7	94	43.3	87	40.1	130	59.9	65	30.0	152	70.0	55	25.3	162	74.7
<b>6- Documentation</b>	133	61.3	84	38.7	134	61.8	83	38.2	45	20.7	172	79.3	42	19.4	175	80.6

### **6.13 Correlation between survey factors**

This section of the analysis intends to establish relationships between the main four factors (Likert scale questions). Correlation analysis is carried out to study the relationship of two or more variables to determine the level of correlation between these variables (Fellows and Liu, 2008). The data analysed were subjected to Pearson coefficient analysis, to confirm the correlation and relationship between each factor of the survey (Likert scale questions). The Pearson correlation is one the most widely used correlation techniques and is commonly used to investigate relationships between two variables (Marczyk *et al.*, 2005). The responses are used to measure relationships, which is recommended to verify the research propositions. The correlated relationships indicate that there is a positive correlation and significant relationship at 0.05 or 0.01 level between each two of the four factors, with a total of six correlations between the factors (see Table 6.20). When the correlation is positive at 0.05 level that means the probability of not having a significant relationship between two different factors is less or equal 0.05. In contrast, when the correlation is positive at 0.01 level that means the probability of not having a significant relationship between two different factors is less or equal 0.01. These correlations also confirm the formulated propositions of the research.

**Table 6.19 Correlation between factors**

<b>Factors</b>		The significance of stakeholder engagement in the variation order management	The significance of stakeholder engagement in the process of variation order management	The integration of the level of power and interest with the current practice will assist to better manage variation orders	Effectiveness of integrating stakeholder power-interest matrix with the current variation order management
The significance of stakeholder engagement in the variation order management	Pearson correlation	1			
	Sig.				
The significance of stakeholder engagement in the process of variation order management	Pearson correlation	0.532**	1		
	Sig.	0.000			
The integration of the level of power and interest with the current practice will assist to better manage variation orders	Pearson correlation	0.419**	0.333**	1	
	Sig	0.000	0.000		
Effectiveness of integrating stakeholder power-interest matrix with the current variation order management	Pearson correlation	0.178**	0.151*	0.398**	1
	Sig	0.009	0.026	0.000	

\* Correlation is significant at the 0.05 level (2-tailed)

\*\* Correlation is significant at the 0.01 level (2-tailed)



These correlations from the above table (6.20) can be described as follows:

(Where  $r$  = the value of the correlation coefficient)

- A positive correlation and significant relationship was found at ( $r= 0.532$ ,  $p < 0.01$ ) between the significance of stakeholder engagement in variation order management and involving the stakeholders in the detailed process of variation order management systems. This finding suggests that, public client and consultant should work together in each step and be informed regarding any action performed by the other, to manage variation orders effectively.
- There is a positive correlation and significant relationship at ( $r= 0.419$ ,  $p < 0.01$ ) between the significance of stakeholder engagement in variation order management and the integration of the level of power and interest with the current practice. This result suggests that the integration of the level of power and interest with the current practice will assist in better managing variation orders.
- From the analysis of the results presented in Table 19, there is a positive correlation and significant relationship at ( $r= 0.178$ ,  $p < 0.01$ ) between the significance of stakeholder engagement in variation order management and the effectiveness of integrating the stakeholder power-interest matrix with the current variation order management. This finding indicates that identifying the level of power and interest by integrating the power-interest matrix in the current variation order management system will assist the stakeholders to manage variation orders effectively.
- A positive correlation and significant relationship was found at ( $r= 0.333$ ,  $p < 0.01$ ) between engaging the stakeholders in the detailed process of variation order management systems and the integration of the level of power and interest with the current practice. This finding suggests that this integration in the detailed process will increase the efficiency of variation order management in the Saudi public construction projects.
- The analyzed data signifies that there is a positive correlation and significant relationship at ( $r= 0.151$ ,  $p < 0.05$ ) between engaging the stakeholders in the detailed process of variation order management systems and the effectiveness of integrating stakeholder power-interest matrix with the current variation order management. From this result, it can be suggested that the integration of the

power-interest matrix in the current process of variation order management system will greatly assist the public client and consultant to better manage variation orders and learn lessons for their future construction projects.

- There is a positive correlation and significant relationship at ( $r=0.398$ ,  $p < 0.01$ ) between identifying the level of power and interest for public client and consultant and the effectiveness of applying the stakeholder power-interest matrix with the current variation order management. Based on this result, it can be recommended that the level of power and interest must be identified in order to apply the power-interest matrix to manage variation orders properly.

## **6.14 Discussion of the findings**

This section of the chapter discusses the findings of the quantitative stage. A discussion on the analysis of the different results presented in this chapter is also carried out, with an attempt made to explain some of the reasons that may be behind these results.

### ***6.14.1 Background information on organisations and respondents***

The first section of the questionnaire administered to both the public sector bodies and consulting firms sought to gain background information on the participants to determine the type of the organisation, years of experience in construction industry and the positions of the respondents within their organisations.

The construction projects are diverse and consist of various different positions and diverse roles of different organisations. As part of the survey it was thought worthwhile to find out the distribution of respondents' positions among their different organisations. A result worth noting was that there was no significant difference between the individual responses due to their different organisations (public sector or consulting firms). This result indicates that the proposed model for this study can be applied for both of them, regardless of who is the source of the variation order, as they have shown the same interests in effective management to improve the practice of variation order management. Additionally, all the respondents have been involved in designing public construction projects, which means that they have faced a variation order, as it is hardly possible to deliver a construction project without any variation orders to design, time, cost and quality in the project's lifecycle, in most of these phases, if not all (Revay, 2002; Ssegawa *et al.*, 2002). This significant finding would provide a good gauge for better practice of variation order management in the Saudi public construction projects.

Referring back to Table 6.4 the collected data on the individual participants indicates that a large proportion (42%) of the participants held senior roles as project managers or design managers. The reason for this, as previously explained, may be attributed to the fact that dedicated effort was made in ensuring that the questionnaires were sent out to the people with strong responsibility for managing the Saudi Arabian construction projects being embarked upon by their organisations. This finding ensures that the information revealed and data gathered from the questionnaire survey would have come from respondents with knowledge of the practices and processes implemented in variation order management by their organisation.

The data which emerged from Table 6.5 on the experience of the respondents shows great depth in the sample, as 30% of the respondents had more than 20 years experience within the construction industry. In addition, two-thirds (66%) of the participants possessed more than 10 years experience within the construction industry. This finding further adds weight to the responses from this survey, the significance being that in addition the respondents being top management employees with huge project management responsibilities in their organisations, these respondents also have significant years of experience within the public construction projects in Saudi Arabia, ensuring that the data collected for the research is from experienced senior professionals with great depth of knowledge and experience in the Saudi construction industry. The important of these factors is that it is hoped the participants have faced various cases of variation orders in the design stage, which would provide a good gauge for better practice of variation order management.

#### ***6.14.2 Better practice of stakeholder engagement in the current variation order management***

As the aim of this survey is to understand what stakeholders believe should happen to improve the practice of variation order management, by determining the optimum level of power and interest of the stakeholders, in order to develop a model that integrates the stakeholder power-interest matrix with the basic principles of variation order management in the Saudi public construction industry, it was crucial to understand the significance of having better stakeholder engagement for best practice. Moreover, it was necessary to identify the level of power and interest to integrate the stakeholder power-interest matrix with the current variation order management and also, to examine the effectiveness of integrating stakeholder power-interest matrix with the current variation

order management. Sections 6.9 to 6.13 present the analysis of the factors in the better management of variation orders.

#### ***6.14.2.1 The significance of stakeholder engagement***

From the analysis of results relating to how respondents in the Saudi public construction industry determine the significance of stakeholder engagement, it appears from Table 6.12 that both public clients and consultants highly agree on having a strong relationship to manage variation orders during the process of variation order management. The reason behind this may be due to the fact that variation orders can lead to disputes and conflicts, which would affect the relationship. Additionally, respondents believe that establishing good communication and cooperation would assist them to better manage variation orders. The reason for this could be due to the fact that consultants make changes, in some cases, without informing the client or the client does not cooperate in managing design changes, which negatively influences the success of variation order implementation. That means they must have good communication with each other to report the most important decisions that have been made in the management process, as negotiation might occur about whether to go forward with the variation order implementation. In this stage, communication between the public client and the consulting firm is essential in order to keep tracking the implementation of the design change effectively and to avoid undiscovered design errors resulting from the change. Moreover, good cooperation between building team members is a major element that can make the task of managing change orders easier.

Respondents agreed to a great extent that being more engaged helps the involved stakeholders in improving management of the variation order process. This is assumed to be due to their perception that there is a lack of knowledge to better manage variation orders in this context. A key finding from the analysis is that the respondents believe identification of the stakeholders' responsibilities assists the design team to better manage the variation order. The reason behind this may be due to the fact that they perceive a clear absence of understanding of the stakeholders' responsibilities during the process of variation order management.

Table 6.13 shows the analysis of how respondents determine the interaction of stakeholders in each step of the principles of variation order management. A detailed look at the analysis reveals that the respondents strongly agree that the client and

designer should meet regularly to manage design changes, but that this also depends on the size and cost of the change. This is assumed to be to avoid time overruns and design errors in managing the change. In addition to that, the public clients and consultants had concerns regarding the problems of cultural diversity and work ethics that may negatively affect the process of variation order implementation.

The results from this section substantiate proposition one of this research, which is *“Determining an appropriate level of stakeholder engagement in the basic principles of variation order management leads to the greater success of the management of variation orders and can improve the communication and relationships among stakeholders”*. The results which emerged from the descriptive analysis strongly indicate that determining the level of stakeholder engagement in the current practice to better manage variation orders in the Saudi public construction projects is regarded as a significant concern. From the analysis of the results, it can be seen that respondents believe that the level of stakeholder engagement can be improved by several techniques such as *having a strong relationship, establishing good communication and cooperation, understanding of stakeholder engagement, identifying of the stakeholders’ responsibilities and regularly meeting to manage design changes*.

#### **6.14.2.2 The level of power and interest**

This section in the questionnaire represented the main aim of the survey, which was to understand what stakeholders believe should happen to improve the practice of variation order management, by determining the optimum level of power and interest of the stakeholders. The optimum level should be identified in each step for best practice of variation order management and to contribute to the proposed model development. Furthermore, this section sought to investigate the efficiency of integrating the power-interest matrix for best practice of managing these orders in the Saudi public construction projects.

The analysis of the data collected from the questionnaire, as presented in section 6.12, shows the frequency and percentage that indicates their level of power and interest for each stakeholder in the principal stages of variation order management. This section of the questionnaire achieved one of the objectives of the survey (refer to section 6.6). This objective is *“to identify the level of power and interest for both public clients and*

*design consultants in each step for best practice of variation order management explicitly”.*

From these results, a power-interest matrix will be designed to locate and identify the position of each stakeholder in each stage for best practice of variation order management. This step would assist in establishing and maintaining a better communication and relationship among the involved stakeholders to to manage variation orders effectively. Additionally, the data received from this section will contribute to the integration of the development to better manage variation orders by identifying the responsibilities of the public client and consultant.

A result worth noting from Table 6.14 is that both public clients and consultants highly agree that integrating the power-interest matrix into the basic principals of variation order management, by determining the optimum level of power and interest of the stakeholders, would assist public clients and consulting firms to better understand their responsibilities to effectively manage variation orders. The reason behind this may be that variation orders are seen to be not well managed in the Saudi public construction projects because certain related issues are not properly established with regards to stakeholder engagement and interaction practices. Hence, this result adds weight to verify the second proposition of the research and to confirm the need to integrate the stakeholders power-interest matrix to better manage variation orders, which is *“Integration of stakeholder power-interest matrix with the current variation order management system will assist the design team to better manage variation orders by improving the cooperation and determining the responsibilities”.*

#### ***6.14.2.3 The effectiveness of integrating the power-interest matrix for best practice of variation order management***

This is the last section of the survey and aimed to investigate to what extent this integration would save time, improve the communication and relationships among stakeholders and overcome disputes and conflicts. Additionally, the section intended to explore whether or not there is a need to develop a system to better manage variation orders in the Saudi construction industry.

The analysis of results relates to how respondents in the Saudi public construction industry determine the effectiveness of integrating the power-interest matrix with the current variation order management system for best practice. It appears that in from Table 6.15 that both public clients and consultants agree to a great extent on the effectiveness of developing a system to better manage variation orders. Particularly, they favour a system that integrates a power-interest matrix and the current basic principles to better manage change orders. The reason behind this may be due to the fact that variation orders are not well managed and implemented in the Saudi public construction projects. Furthermore, the majority of the respondents strongly believe that developing such a system that enhances stakeholder engagement in the process would highly improve the communication process during managing and implementing variation orders. Moreover, they think this integration would speed up the process of change implementation.

The results also indicate that the participants from both the public sector and consulting firms agree that having such a formalised system to manage variation orders would help to avoid of conflicts and disputes among them. This could be due to the fact that variation orders are one of the major causes of conflicts and disputes in the Saudi construction industry.

The analysis of the data received from the questionnaire with regards to this section confirm the third proposition of the research, which is *“Applying a model that integrates the level of power and interest with the basic principles of variation order management would better manage variation orders assist to save time and overcome the potential conflicts and disputes during the process of variation order management”*.

### **6.15 Summary**

This chapter presented a descriptive and statistical analysis of the results which emerged from the quantitative survey. The responses were provided by 217 respondents from both public clients and consulting firms. Different statistical analysis tests were applied by using SPSS statistical software. The results confirmed that there was no significant difference between the respondents' opinions due to their different work organisations. Moreover, there was no significant difference between the respondents' opinions due to their different positions within the construction industry. These key results indicate that the proposed approach to better manage variation orders will be applicable and

acceptable to both parties, namely public client and consultant. The data obtained is indicative of internal consistency, which therefore suggests that the data is reliable. Additionally, the analysis for the Likert scale questions signifies that there is a significant correlation, which indicates the validity of the questions. The most significant result in this chapter is that the research propositions were verified, which is an indication of the need for a model to better manage variation orders.

Further to the statistical analysis, the results obtained were discussed in narrative sections to describe some of the reasons that may be behind these results. The dissection of the results identified the level of power and interest to integrate the stakeholder power-interest matrix with the basic principles of variation order management. The results established the significance and effectiveness of integrating stakeholder power-interest matrix. It can be concluded that there is a significant need to develop a system that identifies the level of power and interest for the involved stakeholders in the design stage in the Saudi public construction projects. This identification would assist the public client and consultant to better manage variation orders, as their responsibilities and authorities in the current practice are not clear enough to them, because the practices of change management are not yet well established in the Saudi context (Chapter 5). In addition, identification of power and interest would improve the communication and relationship among them, to shorten the process of variation order implementation and avoid conflicts and disputes.



## **Chapter 7- Results and model development**

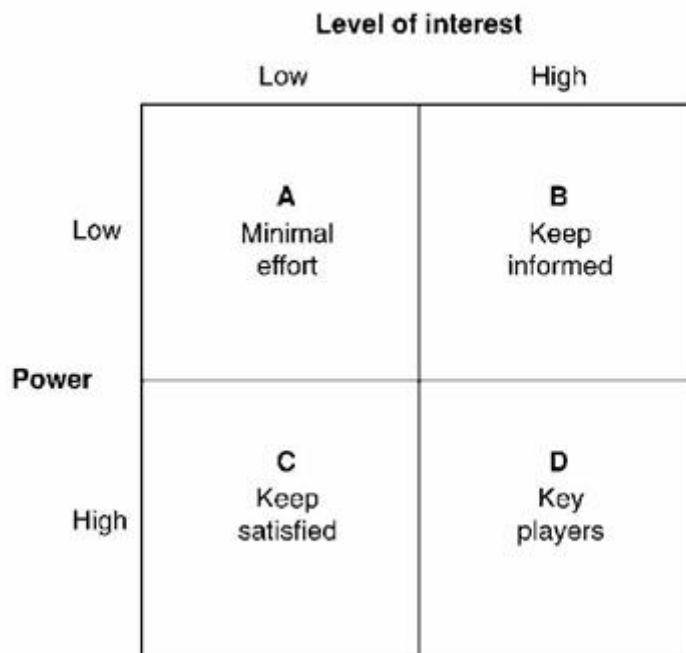
### **7.1 Introduction**

This chapter presents the locations and positions of stakeholders in power-interest matrix in each step for best practice (section 7.2 and 7.3) of variation order management in the Saudi public construction projects, based on the results revealed from the previous chapter. Following that, this chapter illustrates the technique of integrating this matrix with the entire process of variation order management (section 7.2). The position and role of the involved stakeholders, notably the public client and design consultant are identified. Additionally, the repositioning in the integration of power-interest matrix for best practice of variation order management is explained from step to step. The implications of the integrated system to provide best practice are clarified. The integrated system makes several contributions to better manage variation orders. At the end of this chapter, a best practice implementation strategy will be provided, to assist the public clients and design consultants to implement the developed integrated system effectively.

### **7.2 Locating stakeholders in the power-interest matrix**

This section presents the locations and positions of stakeholders in power-interest matrix (see Figure 7.1) in each step to achieve best practice of variation order management in Saudi public construction projects. This identification of the level of power and interest aims to locate the public client and consultant in the matrix to provide a better picture of how communication and relationships among stakeholders can be more effectively employed. Effective communication of stakeholders is imperative to the success of any project in any organisation. A good communication process assists in maintaining good relationships between stakeholders and their organisations (Al-khafaji *et al.*, 2010). Providing information using a well-timed procedure facilitates good communication to develop, support and maintain efficient and continuing relationships among stakeholders (Chan and Yeong, 1995). These different aspects would influence the stakeholders to locate themselves appropriately in the matrix.

Determining the responsibilities and roles of the involved stakeholders to speed up the process and overcome disputes and conflicts between them is one of the questionnaire survey objectives (see section 6.6). This method of locating the stakeholders in the power-interest matrix is based on the findings of the descriptive analysis of the quantitative survey.



**Figure 7-1 Stakeholder mapping, the power-interest matrix**  
**Source: Johnson and Scholes (1999)**

In order to locate the involved stakeholders, namely public client and consultant in the power-interest matrix, the frequency distribution gained from the analysis (Table 6.19) was scaled from 0 to 100 to place the stakeholder in each zone of the matrix. This scale was based on the frequency of high level for each power and interest. The level of power and interest ranged in value from 0 to 100, the higher the scores the higher level of power and interest. The value of these rates would locate the stakeholders in their proper positions in the integrated system of variation order management. Furthermore, it is believed that locating stakeholders throughout the entire set of stages, determining their responsibilities, positions, tasks and the method of engagement would effectively engage stakeholders and improve the practice of variation order management to achieve the best practice.

The stages that will be used to be applied in the matrix are adapted from the current practice of variation order management (section 5.6) which are *(1) identifying the variation order, (2) analysing and evaluating the variation order, (3) estimation, (4) approval, (5) implementation and (6) documentation*. The optimum grades of power and interest are presented in the next sub-sections.

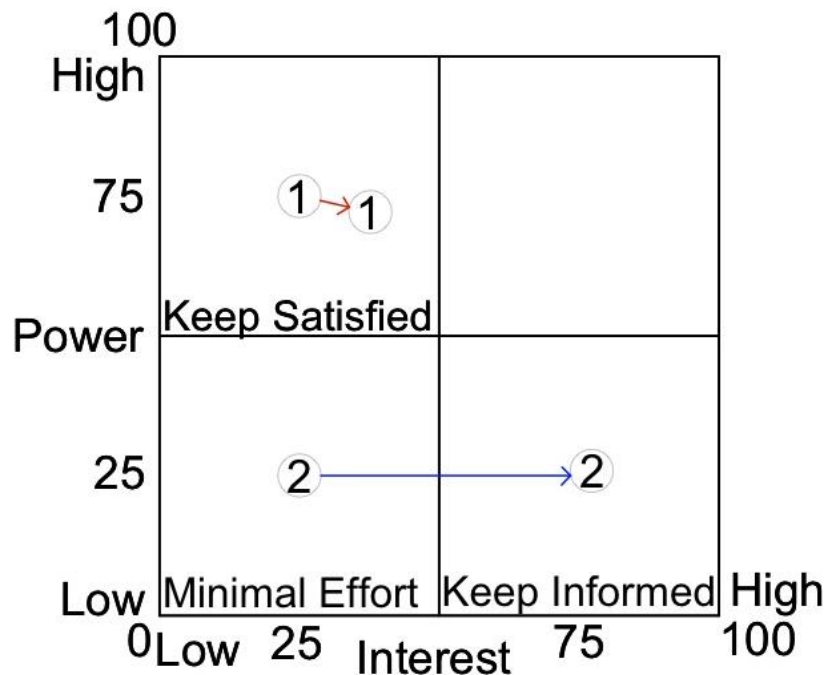
In this context, low level of interest does not mean no interest, also low level of power does not mean no power at all. Moreover, the level of interest may differ in initiating the variation order, based on the source of the variation order, due to absence of a clear contractual agreement. However, the level of interest in managing the variation order should be based on the best practice, to ensure a high performance workflow. The appropriate level of interest will minimise unnecessary interactions by the stakeholders to save time and cost of variation order management.

#### ***7.2.1 Locating stakeholders in the variation identification step***

This stage requires the stakeholders to clearly identify the scope of the initiated variation order, in order to determine the cause, type, impact and source of the variation order. In the first stage of the variation order management process, clear identification is considered as a major step that would assist the project team to evaluate the variation order. In the current practice, insufficient details of the variation order and lack of accessible information, due to the vague responsibilities for the stakeholders, cause deficiencies in managing variation orders (section 5.11).

Hence, for best practice in this step of variation order identification, the public client should have high power and low interest, which means the public client is required to be kept satisfied. It is the most difficult situation in which to keep the public clients satisfied, as it is important to analyse potential intentions and reactions of the clients and to engage them according to their interests. In contrast, the consultant should have low power and high interest to identify the variation order. This means the consultant is required to be kept fully informed of the variation orders that have been initiated and of the major decisions, which have been made, so that good communication with the consultant is vital. This data was collected from the respondents, as previously presented in table 6.19. Figure 7.2, below, presents the locations of public client and design consultant in the current stage, from section 5.10, and their locations for best

practice of variation order management in the power/interest matrix for the variation order identification stage.



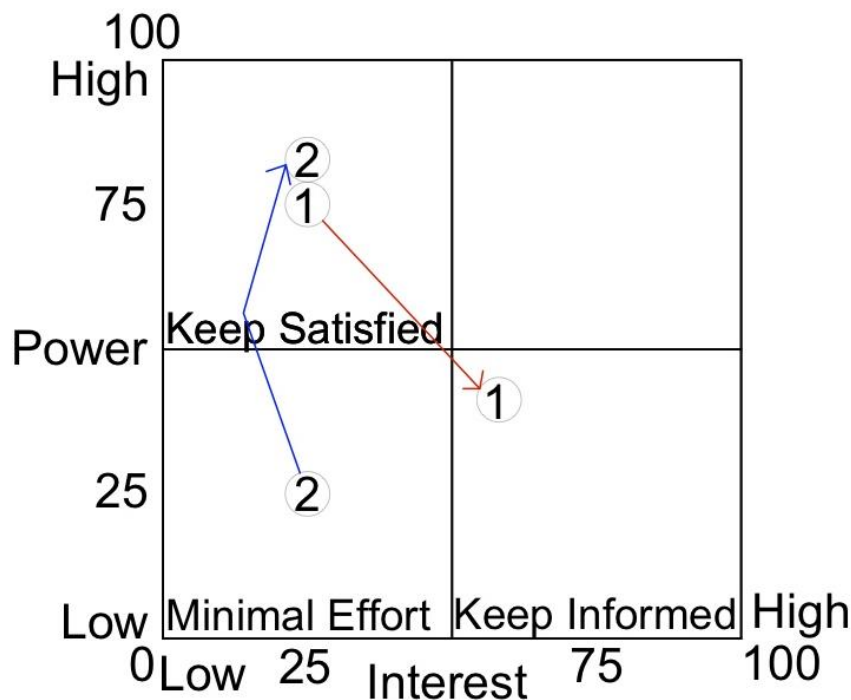
**Figure 7-2 Location of public client and consultant in identification step for current and best practice: 1 represents public client, 2 represents consultant.**

### **7.2.2 Locating stakeholders in the variation order analysis and evaluation step**

In this stage, the stakeholders are required to thoroughly analyse and evaluate the variation order. This stage is important for decision-making for both public client and consultant: whether to go ahead with the variation order or to conduct further investigations. The analyses and evaluation criteria of variation order management cover the aspects that affect the design and project performance during its lifecycle. In the current practice, shortage of professional project team members leads to poor analyses and evaluation of variation orders; also poor stakeholder engagement causes insufficient analysis to evaluate variation orders. Additionally, the high number of unnecessary interactions by the public client negatively influences the success of this stage.

Therefore, to achieve the optimum level of stakeholder engagement in the stage of variation order analysis and evaluation and to overcome the obstacles in the current condition. Figure 7.3, below, presents the locations of public client and design

consultant in the current practice, from section 5.10, and their desirable locations for best practice of variation order management in the power/interest matrix for the variation order analyses and evaluation stage. Based on the descriptive analysis of the data obtained in Chapter 6, in this stage the public client should have low power and high interest for best practice, which indicates that the public client is required to be kept fully informed of the analysis and evaluation of variation orders. Hence, the consultant must have good communication with the public client to inform him about the most important decisions. In addition, it is advisable to keep the public client informed about the issues he is interested in. On the other hand, as the consultant should have high power to analyse and evaluate the initiated variation order and low interest, so he/she must be kept satisfied about the decisions that have been made in this stage. It is therefore necessary to analyse potential intentions and reactions of the consultant in all major developments, and to involve the consultant according to his/her interests.



**Figure 7-3 Location of public client and consultant in analysis and evaluation step for current and best practice: 1 represents public client, 2 represents consultant.**

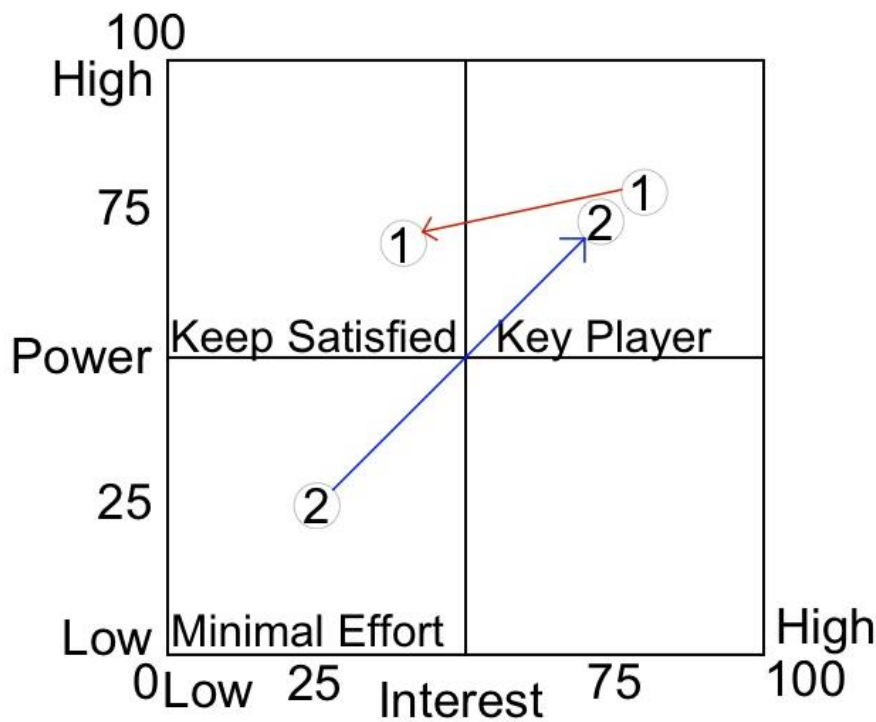
### **7.2.3 Locating stakeholders in the variation cost/time estimation step**

In the third stage of variation order management, the design consultant estimates the cost and duration of the part of the variation order to be implemented in the design stage and also the cost and duration of the variation to be constructed on the site in the

construction stage, in order to get the approval from the public client. The design consultant and public client are required to work closely in an open environment to accurately estimate the cost and time. In contrast, in the current practice, the public client, as the key player in this stage, does not give enough attention to the consultant's decisions due to the lack of the involvement of the design consultant contribution in estimating the cost and time (see section 5.11).

Therefore, to obtain the balance of the optimum level of stakeholder engagement in the estimation stage, for best practice the public client should have a high level of power and low interest, as illustrated in Table 6.19. This indicates that the public client must be kept satisfied about the estimated cost and time to implement the variation order, as this is the most difficult stage in which to manage client satisfaction. Furthermore, the consultant is required to be a key player in this step, as he/she has a high level of power and interest in accurately estimating the cost and time of the proposed variation order, as presented in Figure 7.4. Clearly, the acceptability of decisions to the consultant in this step is a major consideration when estimating the variation order's cost and time.

Figure 7.4, below, presents the locations of public client and design consultant in the current practice, from section 5.10, and their desirable locations for best practice of variation order management in the power/interest matrix for the variation order estimation stage.



**Figure 7-4 Location of public client and consultant in estimation step for current and best practice: 1 represents public client, 2 represents consultant.**

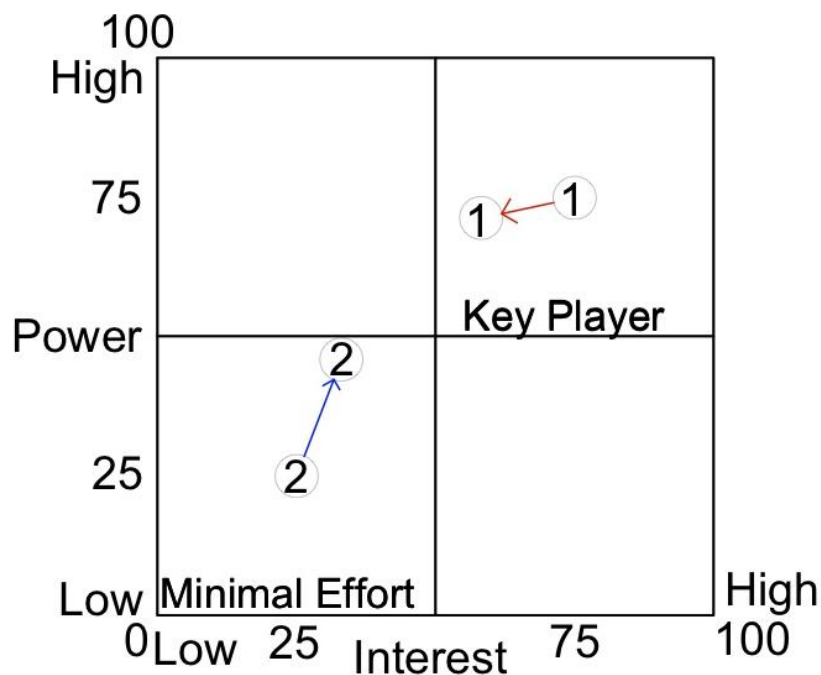
#### **7.2.4 Locating stakeholders in the variation approval step**

In this stage, the public client approval is a significant step, as different outputs are expected. The public client needs to review the potential variation order against the project scope, in order to make the decision on the approval. There are three possible types of approval status, which are: “Yes”, “No” and “Not sure” (see section 5.6). In some cases, negotiations may occur in this stage and/ or the public client asks the consultants for further investigations to make a decision for the proposed variation order. In contrast, in the current condition of variation order management, the lack of clear identification of stakeholders’ responsibilities and negotiation skills, particularly in this stage can cause delay in variation order implementation, due to negotiations taking longer than expected.

For best practice of variation order management, this section locates the public client and consultant in their appropriate locations in the fourth stage (variation approval) of the basic principles of variation order management. The analysis of the results in Table 6.19 shows that in order to obtain the best practice the public client should have a high level of power and interest to approve the variation order from the previous steps. In this step the public client, as the owner of the project, is considered as a key player to

approve the variation order or not, based on the estimated cost and time, and move forward to the next step. In contrast, the consultant requires a minimal effort from the client, as he/she should have low power and interest, as presented below in Figure 7.5. The public client should keep the consulting firm informed to the necessary extent, but should not spend too much effort on this.

Figure 7.5, below, presents the locations of public client and design consultant in the current practice, from section 5.10, and their desirable locations for best practice of variation order management in the power/interest matrix for the variation order approval stage.



**Figure 7-5 Location of public client and consultant in approval step for current and best practice: 1 represents public client, 2 represents consultant.**

### **7.2.5 Locating stakeholders in the variation implementation step**

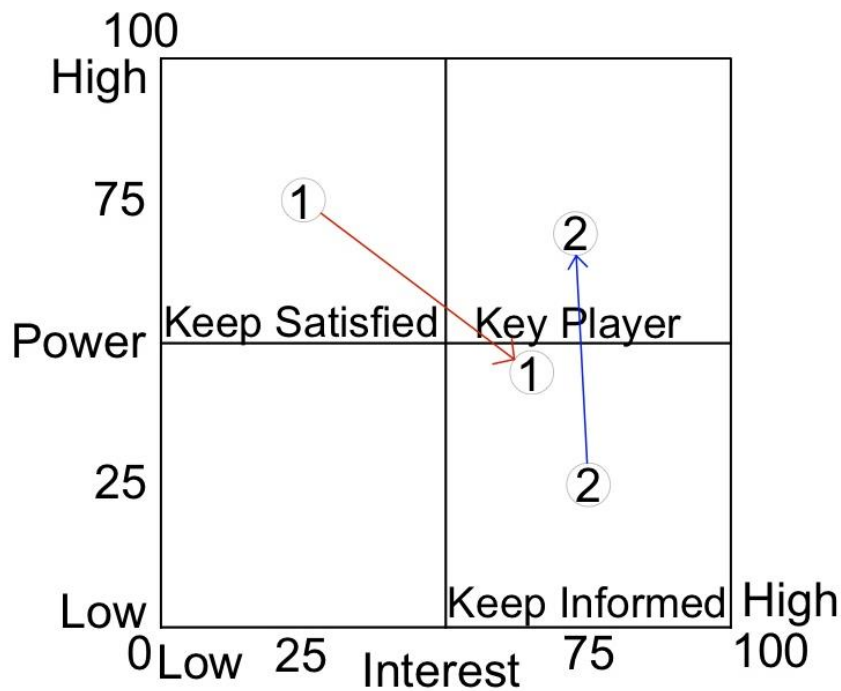
Both public clients and consulting firms are highly encouraged to have good communication skills among project teams in this stage, to assist them in timely implementation. Furthermore, design team involvement and co-operation among different disciplines will assist the stakeholders in the design review stage to avoid



design errors due to poor implementation of design changes. In the current practice, the analysis of the exploratory interviews in Chapter 5 reveals the causes that have led to poor variation order implementation. These are: the absence of an effective work environment and lack of follow-up procedures, which influence the consultant's ability to implement the variation order efficiently.

Thus, for best practice to achieve the optimum level of stakeholder engagement in the stage of variation order implementation and to avoid the current deficiencies, the descriptive analysis in Table 6.19 indicates that in the variation implementation step the public client is required to be kept fully informed about variation order implementation in the design. Here, the client should have low power and high interest for best practice of variation order management. Additionally, the public client must be informed of the major decisions which have been made by the consultant in this stage, so that good communication with the public client is essential. However, as the consultant plays a key role in the implementation step, the consultant should have a high level of power and interest to implement the variation order (see Figure 7.6). This means the public client must accept the decisions that have been made by the consultants to implement the variation order.

Figure 7.6, below, presents the locations of public client and design consultant in the current practice, from section 5.10, and their desirable locations for best practice of variation order management in the power/interest matrix for this implementation stage.



**Figure 7-6 Location of public client and consultant in implementation step for current and best practice: 1 represents public client, 2 represents consultant.**

#### **7.2.6 Locating stakeholders in the variation documentation step**

After the physical implementation of the variation order in the design stage, the variation order should be archived for future construction projects. This stage assists public clients and consultants to learn lessons and build up their knowledge from the implemented variation orders, for future experience. The causes of the incorrect locations of stakeholders in the variation order documentation stage in the current practice can be identified as: shortage of data-based knowledge (this is because the public client does not give the design consultant enough attention to enable him to document and archive the variation order to learn lessons from it for their future projects); stakeholders' unawareness of the significance of this stage (this is a major cause of the high occurrence of variation orders, design errors and the problems associated with variation order management). This issue can be considered as arising because the stakeholders have not learnt from the previous process of managing the variation orders.

In the last step of the basic principles of managing variation orders, variation documentation, for best practice and to gain benefits from the previous stages of the developed model, the public client needs a minimal effort, according to the statistical

analysis presented in Table 6.19. Here the public client should have a low level of power and interest, for best practice. In this step the consultant should keep the public client informed to the necessary extent, but should not invest too much effort in the client. On the other hand, the consultant should have a high power and interest which means that he/she is a key player in documenting the variation order. The location and position of the public client and consultant for best practice of variation order management is presented in Figure 7.7.

Figure 7.7, below, presents the locations of public client and design consultant in the current practice, from section 5.10, and their desirable locations for best practice of variation order management in the power/interest matrix for the variation order documentation stage.



**Figure 7-7 Location of public and consultant in documentation step for current and best practice: 1 represents public client, 2 represents consultant.**

### 7.3 Stakeholder mapping in the best practice

After analysing the data obtained, discussing the findings of the quantitative stage of the research (section 6.14) and locating the involved stakeholders in the power-interest matrix for most effective variation order management (best practice), this section

intends to describe the technique of integrating this matrix with the entire process of variation order management, in order to obtain best practice. Here, best practice can generally be defined as “*methods and techniques that have consistently shown results superior than those achieved with other means, and which are used as benchmarks to strive for*” (Bogan and English, 1994). However, no practice is best for everyone or in every situation, and no best practice remains best for very long, as professionals keep on finding better ways of doing things. In this research, best practice of variation order management is a method that saves time and cost on construction projects, improves the design quality and leads to less conflicts during the process of variation order management. Best practice is needed because, in the existing condition, there is no formalised approach in the context of the study to manage variation orders. (See section 5.5). Hence, the best practice attempts to avoid the shortcomings and find solutions to better manage variation orders.

This method will integrate the power-interest matrix with the basic principles of variation order management in the Saudi public construction projects by determining their responsibilities, positions, tasks and the method of engagement and communication to effectively engage stakeholders and better manage variation orders. To make the developed model happen in practice, the position and role of the involved stakeholders, notably the public client and design consultant will be identified and how their positions will change from step to step (this issue is explained in section 7.5). Therefore, there are certain requirements to guarantee the model’s clarity and applicability to facilitate the move from the current practice to best practice. These requirements are explained in each stage of the model. The developed model is shown in Figure 7.8 and discussed below.

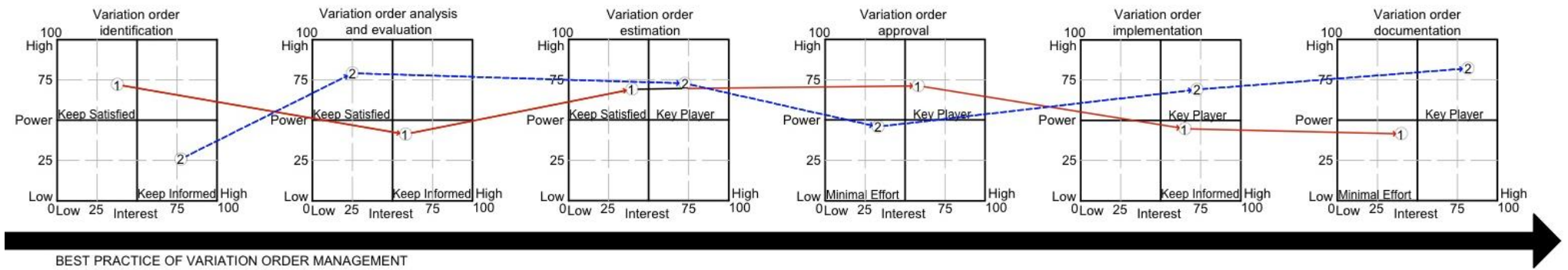


Figure 7-8 Best practice model of variation order management: 1 represents public client, 2 represents consultant.

***Variation order identification:*** This is the first stage of the basic principles of variation order management. In this stage full variation order identification will highly assist the project team in evaluating the variation order and also during implementation. The public client or the consultant identifies and initiates a variation order. Identifying and initiating variation orders at early design stages can help the design team to manage variation orders effectively and minimize the negative impact of the variations. Identifying variation order proposal includes: variation order type, cause and initiator.

In this stage assessing the importance of the stakeholders is a key part of the successful identification of the initiated variation order to obtain best practice. The results indicated that the public client should have a high power to initiate variation orders, as he is the owner of the project and low interest in how this variation order will be fully identified, as he believes this is part of the design consultant responsibilities. Here, the consultant must keep the public client satisfied with the full identification of the variation order. As pointed out above, this is the most difficult situation for the consultant to keep the public client satisfied, and analyse his intentions and reactions.

In contrast, the consultant should have a low power in initiating variation orders in the design stage and high interest in identifying the type and cause of the initiated variation order, to assist him/her to evaluate and implement the variation order effectively. This means the public client must keep the consultant fully informed of the variation orders that have been initiated and of the major decisions, which have been made, so that good communication with the consultant is vital to ensure that the variation order is well identified to avoid any potential errors. In order to make the best practice happen, the client should be located as he is in the current practice. In contrast, the level of interest for the design consultant should be increased to help him/her to analyse the potential intentions and reactions of the client.

***Variation order analysis and evaluation:*** analysing and evaluating the variation order is the second stage of the current practice of variation order management. This step is important for decision-making for both public client and consultant, whether to go ahead with the variation order or to conduct further investigations. The evaluation criteria of variation orders management covers the aspects and analysis that affect the design and project performance and also the need for the variation order.

In this stage based on the descriptive analysis of the data and resulting discussions, the public client should have low power in evaluating the variation order and high interest in being educated about the importance of the variation order. This indicates that the consultant is required to keep the public client fully informed about the variation order evaluation. That means the consultant must have good communication with the public client to report the most important decisions that have been made in this stage. Furthermore, the consultant is highly recommended to keep the public client informed about the issues he is interested in, to avoid any unexpected matters.

On the other hand, to assure that this stage is well managed, the results from the quantitative survey show that the public client must keep the consultant satisfied about the variation order evaluation and the decisions that have been made in this stage. Here, the design consultant should have high power to analyse and evaluate the need for and impact of the variation order on the project design, to ensure that the variation order has been well analysed and evaluated to go ahead with it. Additionally, the consultant should have low interest in the outcomes of the variation order evaluation, as it is mostly the public client who approves the variation order evaluation. It is therefore necessary to analyse potential intentions and reactions of the consultant in all major developments in this stage, and to involve the consultant according to his/her interests, in order to guarantee that the variation order is analysed and evaluated efficiently. Ideally, at this stage, the level of power should be decreased to avoid any unnecessary interactions and the level of interest should be increased for the public client, to create an accessible environment. However, the level of power for the consultant should be high, to assist the consultant to better analyse and evaluate the variation order.

***Variation order estimation:*** The third stage of the current practice of variation order management in the Saudi public construction industry is the variation order cost and time estimation. Generally, in this stage, the consulting firm estimates the cost and duration of the variation order itself to be implemented in the design stage, also the cost and duration of the variation to be constructed in the site in the construction stage, in order to get the approval from the public client. This estimation is based on the previous steps of the variation order management practices. The communication during this stage between the stakeholders is significant, as negotiation might occur about whether to go forward with the variation order implementation.

From the results and discussion it can be recommended that the public client should have a high level of power to approve the variation order cost and time and has low interest in the method of how the consultant would estimate the cost and time. This finding indicates that, the public client must be kept satisfied by the consultant about the estimated cost and time to implement the variation order. This stage is considered to be the most difficult stage for the consultant to manage the public client satisfaction.

In contrast, as the consultant is required to be a key player in this step, he/she should have a high level of power to estimate the cost and time of the variation order and has a high level of interest in identifying the cost and time estimation. Clearly the acceptability of decisions in this step to the consultant is a major consideration when estimating cost and time. Hence, the public client must let the consultant to work in this stage as a key player, in order to manage cost and time of the variation order effectively. This integration of the factors of the power-interest matrix in the variation order management process will assist both consultant and the public client to cooperate to estimate the cost and time of variation order implementation accurately. Here, best practice can happen by decreasing the interest of the client to keep him satisfied with the decisions. Moreover, increasing the power and interest of the consultant would help to move from the current practice to the ideal situation.

***Variation order approval:*** This is the fourth step of the current practice and basic principles of variation order management. Moreover, this step works closely with the previous estimation step. The approval by the public client is a significant step, here, as different outputs are expected, i.e. *No*, *Yes* or *Not sure* (which leads to further negotiation). The public client needs to review the potential variation order against the project scope in order to make the decision for the approval. Here three possible approval status, which are:

- ‘Yes’ where the public client approves the proposal of the variation order
- ‘No’ where the public client rejects the variation order proposal
- ‘Not sure’ where the public client is not sure about the proposal of the variation order due to its cost or time implementation, the consultant and public client are encouraged to review and negotiate the proposed variation to reach a compromise. If the client and consultant did not agree on cost or duration of the



variation order proposal then the variation is rejected. However, when both parties are agreed on the estimated cost and time implementation for the variation orders, then the variation orders is approved.

In some cases for minor variation orders that do not affect the design or the project baseline, the consultant implements these variation orders without getting the approval from the client.

The analysis of the results from the descriptive statistics shows that the public client should have a high level of power and interest. In this step, for best practice, the public client is considered as a key player to approve the variation order or not, based on the estimated cost and time, and move forward to the next step, as he is the owner of the project. Therefore, the consultant must accept the decision of the public client in this stage.

On the other hand, the consultant requires a minimal effort by the public client, as he/she should have low power to influence the decision of the public client to approve the variation order. Moreover, the design consultant should have low interest in the public client's decision whether to approve the initiated variation order or not. In this step of the integration of the power-interest matrix, the public client should keep the consulting firm informed to the necessary extent, but should not spend too much effort on this, in order to speed up the process of variation implementation. In order to practice this stage ideally, the public client and design consultant should retain their relative positions as in the existing condition. However, they should review the variation order against the project scope to ensure the proposed practice works efficiently.

***Variation order implementation:*** From the exploratory study of the research in Chapter 5, implementing the variation order was identified as the fifth step of the current variation order management system in the design stage. This occurs after obtaining the approval from the public client in the previous step. The communication between the public client and the consulting firm is essential in order to keep tracking the implementation of the design change effectively and to avoid undiscovered design errors resulting from the change.

The descriptive analysis in the previous chapter indicates that the public client is required to be kept fully informed about variation order implementation and any potential aspects that might occur due to the variation order implementation in the design. The public client should have low level of power in the techniques of variation order implementation; however he should have high level of interest in how the proposed variation order will be implemented in this stage. Additionally, the public client must be informed of the major decisions, which have been made by the consultant in this stage, so that good communication with the public client is essential.

Here, as the design consultant plays a key role in implementation step, he/she should have a high level of power to implement the variation order in the design and a high level of interest, as well, to ensure that the variation order is implemented properly. This means that the public client must accept the decisions that have been made by the consultants to implement the variation order. In this significant stage of variation order management, effective communication skills among project teams would highly assist in the timely implementation. Furthermore, design team involvement and co-operation among different disciplines will assist in the design review, to avoid the potential design errors during implementation of the design change. Moving to the ideal situation involves decreasing the power of the client and increasing his level of interest, to implement the variation order successfully and create a healthy business environment among the stakeholders. In addition, the level of power for the consultant should be high, to allow the design team to cooperate effectively.

***Variation order documentation:*** The final step in current practice of variation order management is the documentation of the variation order. After the physical implementation of the variation order in the design stage, documentation of the variation order should be archived for future construction projects. This stage assists public clients and consultants to learn lessons and build up their knowledge and experience.

The statistical analysis earlier in Chapter 6 sought to integrate the power-interest matrix for best practice of the process of variation order management system properly. These results for this step suggest that the public client needs a minimal effort in the variation documentation step, as the client should have a low level of power and interest in archiving the process of the variation order. In this step, the consultant should keep the

public client informed to the necessary extent, but should not invest too much effort towards the client, to finalise the variation order implementation and not to negatively influence the project design performance.

On the other hand, the consultant should have high level of power and interest to document the implemented variation order. This means that the design consultant is a key player in this step to document the variation order to learn lessons from that design change and the process of managing it, and also to reserve his/her rights against unexpected future claims by the public client because of the variation order. In order to move from the current practice in this stage to best practice, requires a decrease in the level of power for the client, to allow the design consultant to review the variation order implementation properly. Furthermore, the ideal practice requires giving a high level of power and interest to the design consultant, to ensure the variation order is well archived and documented to learn lessons from it for future projects.

#### **7.4 Implications of the developed integration for the best practice**

This section clarifies the implications of the developed integration of stakeholder mapping, particularly the power-interest matrix for best practice of variation order management in Saudi public construction projects. It is assumed that applying the developed integration would better manage variation orders in the design stage in Saudi public construction projects. The developed model would lead to effective communication and cooperation among stakeholders, shorten the time of variation order implementation and assist in overcoming the potential conflicts and disputes because of the variation orders. It was taken into consideration that simplification was needed in designing the developed model for best practice of variation order management, in order to make it understandable and applicable. The reason behind this need for facilitation was because stakeholder engagement during the process of variation order management is not yet a well-established practice in the Saudi construction industry.

In order to improve the workflow and to speed up the process of variation order management, it is important to clarify that a greater level of stakeholder engagement does not always mean greater success of variation order management. Additionally, a low level of stakeholder engagement does not always mean failure to manage variation orders. Hence, determining an appropriate level of stakeholder engagement is required to lead to greater success of variation order management. For instance, in some stages of

this integrated system, the public client or consultant requires minimal effort from his or her counterpart. The reason behind this low level of stakeholder engagement is to save time in unnecessary meetings and engagement, have effective communication and avoid any potential conflicts and disputes due to an inappropriate level of engagement.

Another point worth noting here, in a single stage in the best practice, both public client and design consultant cannot have an equally high level of power and interest. This means that, in the best practice, both of the stakeholders would not be key players in a particular stage, to ensure a high performance workflow and avoid any potential conflicts and disputes among them. Likewise, public client and design consultant do not both have a low level of power and interest in a specific stage, in the best practice. This means both of the stakeholders would not give even a minimal effort in a particular stage; this is to guarantee at least one of them is fully aware in that stage.

The developed model for best practice of variation order management starts with the first stage in the current practice, which is *variation order identification*. In this stage, to well identify the variation order, public client and design consultant are encouraged to discuss and identify the variation order by educating them about the importance of defining the scope of the initiated variation order to determine the cause, type, impact and source of the variation order. Here good identification of these aspects at the beginning of the variation order management process would greatly assist the design team to better manage it. Determining an appropriate level of stakeholder engagement would help the public client and consultant to identify the variation order effectively. The appropriate level of engagement requires the public client to be kept satisfied with the variation order identification. In contrast, the design consultant is required to be fully informed about the public client's decisions.

The second stage of the integration for better management of variation orders is to *analyse and evaluate the variation order*. Here, the public client and design consultant are recommended to create an environment that allows them to be engaged properly and communicate in a timely manner with one another openly, thus assisting the design consultant and public client to analyse and evaluate the need for the variation order efficiently. To do this better requires the public client to be informed about the evaluation decisions made by the consultant. Additionally, the consultant is required to be satisfied with the authority and responsibilities he/she should hold to allow him/her

to study and evaluate the variation order successfully. Hence, in order to implement the integration successfully the public client is required to allow the consultant to manage this stage without any interference.

After the stakeholders identify and evaluate and analyse the variation order, *estimation of the variation order time and cost* is carried out as the third stage in the developed model. This stage is significant to implement the variation order but may take a longer time than other stages, as negotiations are likely to occur. That means stakeholders might face unexpected obstacles that could affect the management of the variation order estimation and lead to conflicts and disputes among them. Therefore, the public client and the design consultant are encouraged to work together in effective environment of communication and cooperation. Here, the suitable level of stakeholder engagement requires the public client to be kept satisfied by the consultant about the variation order estimation while the design consultant plays a key role to estimate time and cost accurately.

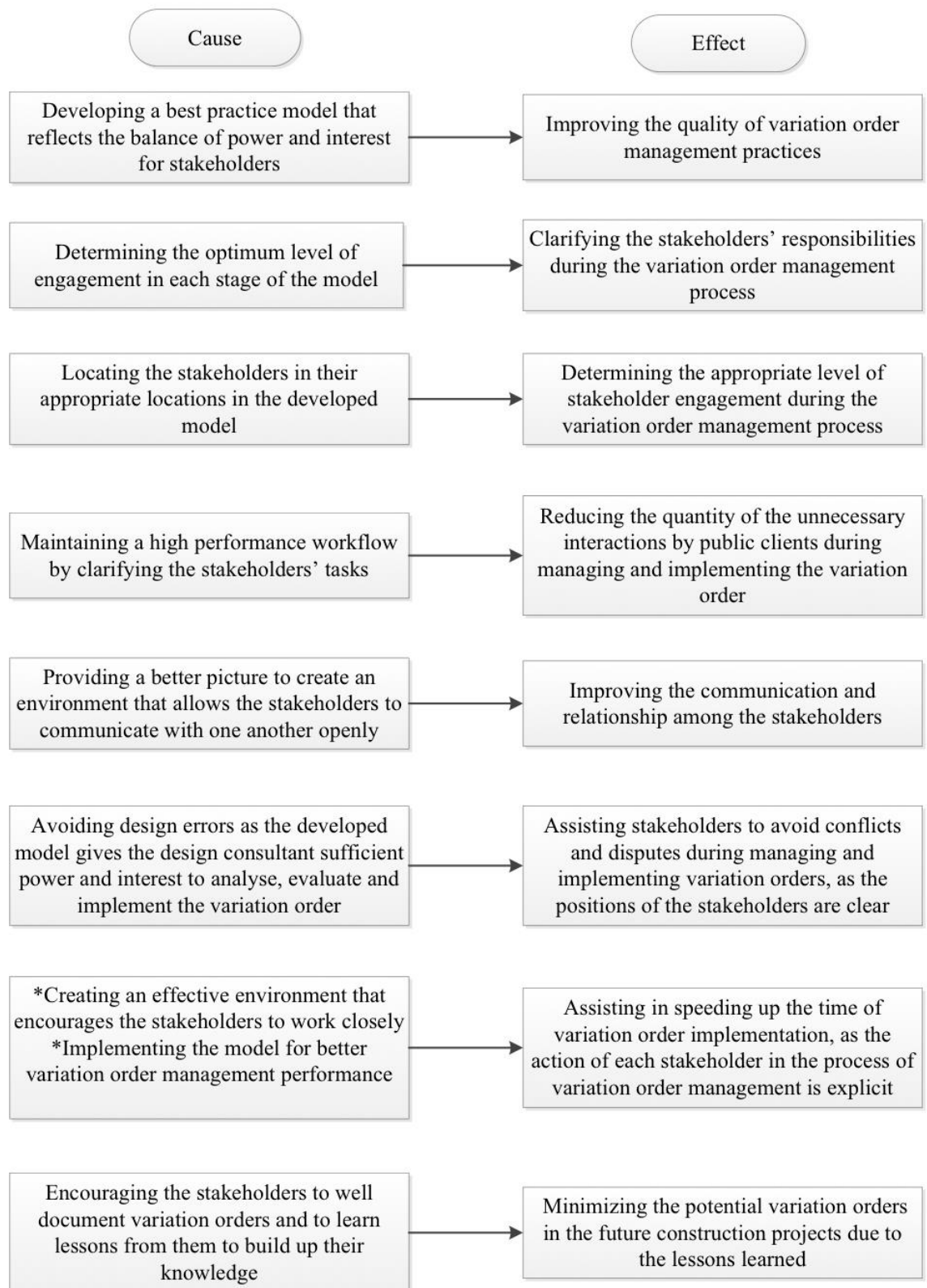
In the fourth stage, *the variation order approval*, the consultant is required to work closely with the public client as the public client approval is significant to approve or reject the variation order. It is obvious that the public client is considered as the key player in this stage. In contrast, the consultant requires minimal effort by the client in this stage. Hence, the integration recommends the design consultant to accept the client's decision whether to go ahead for the variation order or not. However, if the client rejects the variation order, the consultant should have enough experience to deal with the client's decision in order to avoid unexpected claims that might affect design performance.

The fifth stage of the model is to *implement the variation order*. In this stage, the public client and design consultant are recommended to create an environment that allows them to be engaged properly and communicate and cooperated with one another openly. This stage needs effective communication and engagement to assist the design consultant and public client to implement the variation order efficiently. The importance of this stage is that any error in the variation order implementation might not be seen in the design stage as most of the variation orders in the construction stage occur because of poor implementation of a variation order in the design stage (Arian and Pheng, 2007). The proper level of stakeholder engagement to avoid poor implementation of the

variation order requires the consultant to be the key player in this stage. Moreover, the public client needs to be informed by the consultant about any changes that have occurred in the design.

After the physical implementation of the variation order, *the variation order documentation* is the last stage in the best practice of variation order management. In this last stage, public client and design consultant are encouraged to review the implemented variation order and to ensure it is well documented. Here good documentation would help the stakeholders to learn lessons and build up their knowledge from the implemented variation orders for future experience. An appropriate level of stakeholder engagement would help the public client and consultant to archive the variation order effectively. This stage of the developed integration of the power-interest matrix for best practice of variation order management requires the consultant to give the public client minimal effort. This means the consultant should keep the public client informed only to the necessary extent, as the client has no significant interest and power. However, the design consultant is required to be a key player to reserve his/her rights for unexpected future claims from the public client. The proper documentation will save the design time, avoid further changes, enable lessons to be learnt and overcome disputes and conflicts among the stakeholders.

To summarise the section, here are some of the key implications of the developed model. These key implications are divided into two main parts, namely, the causes and the effects of these implications in the developed model for best practice, as presented in Figure 7.9. Also, this figure explains what are the causes that have led to improve the practice of variation order management and how these improvements will positively affect the stakeholders for better engagement.



**Figure 7-9 Causes and effects of better variation order management**

These positive implications resulting from the developed model for best practice of variation order management are not yet established in the existing practice. Hence, the understanding of the causes and effects of the developed system of variation order management can make several contributions to better manage variation orders in the Saudi public construction projects. This is important because current practice does not consider the following points:

- Providing a better picture of communication and relationships among stakeholders to practice the variation order management systems effectively.
- Determining the responsibilities and roles of the involved stakeholders to speed up the process and overcome disputes and conflicts.
- Explaining the appropriate level of stakeholder engagement to ensure greater success of variation order management.
- Maintaining a high performance workflow to avoid unnecessary interactions between the stakeholders to save the time and cost in the variation order management.
- Encouraging the stakeholders to document the initiated variation orders well, to learn lessons and build up their knowledge.

However, the best practice is based on acknowledgement of the importance of the above points to manage variation orders effectively. These points were covered in the developed model of variation order management (see section 3 in this chapter).

To achieve the aim of the study to improve the practice of variation order management in the Saudi context, the key positive implications of the developed model and the avoidance of the deficiencies in the current practice should be translated into a reality that can be applied effectively. This step will be performed through designing a best practice implementation roadmap strategy to enable the stakeholders involved in the change process to fully understand the task at hand, better allocate available resources and prepare for effective variation order management practices (see section 7.6 for more details).

## **7.5 Repositioning the stakeholders in the developed integration**

Changing the positions of the stakeholders is the most challenging issue during the integration of the power-interest matrix with the basic principles of variation order



management to reflect the best practice balance of power and interest in each stage. Repositioning stakeholders must be well managed to successfully implement the developed model in Saudi public construction projects. This challenge could arise due to a misunderstanding of the mechanism and/or poor implementation of the model for best practice of variation order management and also culturally-related issues, which can lead to the stakeholders being not actively engaged.

However, all these improvements to the current practice can be applied if the project parties apply the basic principles of the variation order management process. Moreover, the developed best practice adopts the current process of variation orders while integrating the stakeholder power-interest matrix for better management. However, in order to guarantee the highest efficiency for better management of variation orders in the Saudi public construction projects requires educating the public client and the design consultant on the mechanism of the best practice. Educating the involved stakeholders can be done by providing a brief of the mechanism of the integrated system in the terms and conditions of variation orders in the contract.

The results from the quantitative survey indicate that, cultural diversity between public clients and consulting firms negatively influences the performance of variation order management. Although the developed model relates to variation order management, attention is paid to culturally related issues and the need for culture change to successfully make the best practice happen. Hence, for effective application of the developed model, the influence of the design consultant is important in changing cultures and raising public client awareness with regards to stakeholder engagement and variation order management in the construction industry.

Additionally, guidelines must be provided to explain the method of stakeholder repositioning. To do so, the roadmap in the following section describes the strategy of best practice implementation and will take into consideration the issue of repositioning stakeholders from stage to stage.

## **7.6 Process of the roadmap design**

In construction organisations multi-disciplinary teams experience conflicts, complexities, uncertainties and ambiguities with traditional practices that impede

knowledge sharing and thus cause duplication of processes. However, developing best practices alone cannot influence the required changes. Barriers recognised by researchers include many factors, such as a need for well-defined process models (Bernstein and Pittman, 2004). It is widely recognized that many organisations have gaps between what they know and what they do (Pfeffer and Sutton, 2000). Therefore, it is imperative to establish an effective implementation strategy that requires significant changes in the form of stakeholder engagement during the process of variation order management.

In this research context, the current practice of variation order management in the Saudi public construction industry fails to manage variation orders efficiently, even though they adopt the basic principles of variation order management systems. This finding emerged from the qualitative analysis in Chapter 5. This issue could be attributed to the fact that there are currently no formalised approaches to manage variation orders during the design process in the Saudi public construction industry. The participants of the exploratory interviews (section 5.5) put a high emphasis on the lack of stakeholder engagement and interaction during the variation order management process, which leads to poor management. Furthermore, stakeholders' responsibilities are not clear enough with regards to change processes.

The researcher intended to link the stakeholder engagement and the process of variation order management in the Saudi public construction projects. However, study of the existing body of literature on the construction industry revealed that little or no attention has been paid to the integration of stakeholder engagement with the variation order management systems. Therefore, it was imperative to formulate research propositions (see section 6.5) to confirm the purpose of integrating stakeholders with the current practice, to better manage variation orders. For this reason, a questionnaire was designed to support the research propositions and to understand the level of power and interest of the stakeholders to develop a model that integrates stakeholder power-interest matrix with the process of variation order management.

The research propositions were verified and confirmed. Additionally, based on the above different approaches, an integration system was developed to effectively engage the involved stakeholders, namely the public client and design consultant, with the basic principles to better manage variation orders. However, there is a concern that this

developed system may also fail to work in Saudi public construction projects. This concern arose from the qualitative analysis of this research (section 5.4) which indicates that there are clear shortcomings in the regulations and instructions of the Standard Public Works Contract (SPWC) in Saudi Arabia, notably with regard to managing design changes and stakeholder responsibilities in the design stage. These shortcomings could lead to misunderstanding of how to implement the best practice process properly. Consequently, the integrated system of best practice to manage variation orders may fail to work in the Saudi construction industry

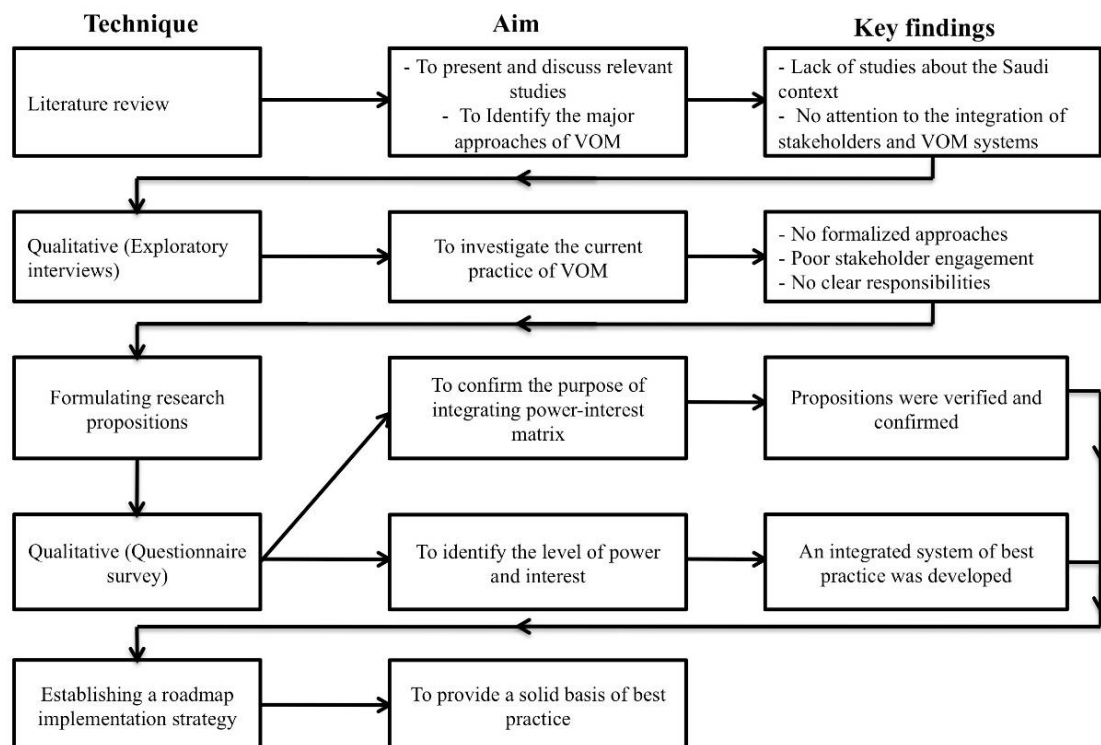
Here, the researcher attempts to design a unique roadmap based on the previous research stages, techniques, aims and key findings, as presented in Figure 7.10. The key findings were translated to different elements that support the effective implementation of the best practice model. This uniqueness comes from the elements of the roadmap that link the best practice of variation order management with its requirements for successful implementation. Additionally, the roadmap will be categorised in two different ways: firstly, based on the priority of the main three elements in the roadmap (see section 7.7) and secondly on the reflection of each element of the roadmap in the current practice (see section 7.8).

According to the Cambridge Business English Dictionary (2013), a roadmap is “*a plan for how to achieve something*”. Dixon (2007) states that roadmaps will assist to develop a workforce that is able to apply the new system and will outline methods to ensure the system’s sustainability. A strategic roadmap enables the stakeholders, in the context of this study, public clients and design consultants, to obtain a complete vision of the future of the model application to turn the best practice into action. This enables the public clients and design consultants to link the practice of variation order management into design stage priorities.

Generally speaking, a roadmap describes the future environment for a business or organisation, any objectives to be achieved within that environment, and the plan for how those objectives would be achieved. It lays out a framework to help stakeholders understand how different elements can fit together, work together, and develop. It links applications, technical challenges, and technological solutions while helping to set priorities that will achieve these objectives (Albright, 2003; Kostoff and Schaller, 2000). As in this study, the developed roadmap links the variation order management

process with the stakeholder engagement activities. In other words, roadmap explains a set of future objectives and answer a set of “*why-what-how-when*” questions in order to develop a “*to-do*” list to achieve the desired objectives (Albright, 2002).

The designed roadmap could pave a solid foundation for the stakeholders to move from the current practice to best practice to implement the variation order management model effectively. In addition, it would help the design consultants and public clients to understand the mechanism of the developed model and avoid any potential obstacles due to the lack of sufficient information in the existing conditions.



**Figure 7-10 The process of the roadmap design**

## 7.7 Best practice implementation roadmap

This section of the research aims to provide a basis for a viable best practice for a variation order management system and guidance for its implementation. This stage has been reached after designing the conceptual model to understand the mechanism of the current practice (section 5.6), then determining the weaknesses in the current condition to identify the obstacles and evaluate the need for a developed method that will avoid the problems associated with the current practice (section 5.7), subsequently developing a model that solves the shortcomings to improve the practice of variation order

management (section 7.3), In the light of the findings from the qualitative and quantitative surveys, the results suggest that a certain level of intervention by experts and practitioners in the construction industry is required before the best practice is effectively implemented. To this end, it is envisaged that the roadmap will help the public clients and design consultants understand the task at hand, better allocate available resources and prepare for effective variation order management. The convergence of the results from the existing literature review, the exploratory interviews and the questionnaire have highlighted a number of key elements, which are illustrated in the roadmap in Figure 7.11.

From these findings, the key elements of the roadmap are based on the most common causes of the current poor variation order management, the potential challenges that may prevent the developed model from being efficiently implemented, the professional guidelines required for successful implementation of the best practice and effective implementation strategy. Addressing these elements in a roadmap of the implementation strategy will facilitate the entire model to work out efficiently to achieve its objectives to improve the practice of managing design changes.

To link the different elements that emerged from the previous stages of the study to design a roadmap (see Figure 7.10), it is assumed that setting priorities will assist the stakeholders to achieve the objectives of the integrated system of variation order management. In the developed roadmap implementation strategy there are three priorities to guarantee the highest efficiency for successful development and implementation of the proposed model.

The first priority of the roadmap is identifying the challenges to moving on and applying the best practice, as the developed model cannot effectively achieve its objectives without taking the potential challenges into consideration,. Then, to enable the workflow of the model to work out smoothly, it proposes a professional strategy, as this is a key element in order to involve the stakeholders efficiently in the best practice process. Finally, it points out key elements of the guideline, to enable the stakeholders to understand the process of the best practice. The concepts in the roadmap are elaborated below in the following sub-sections.

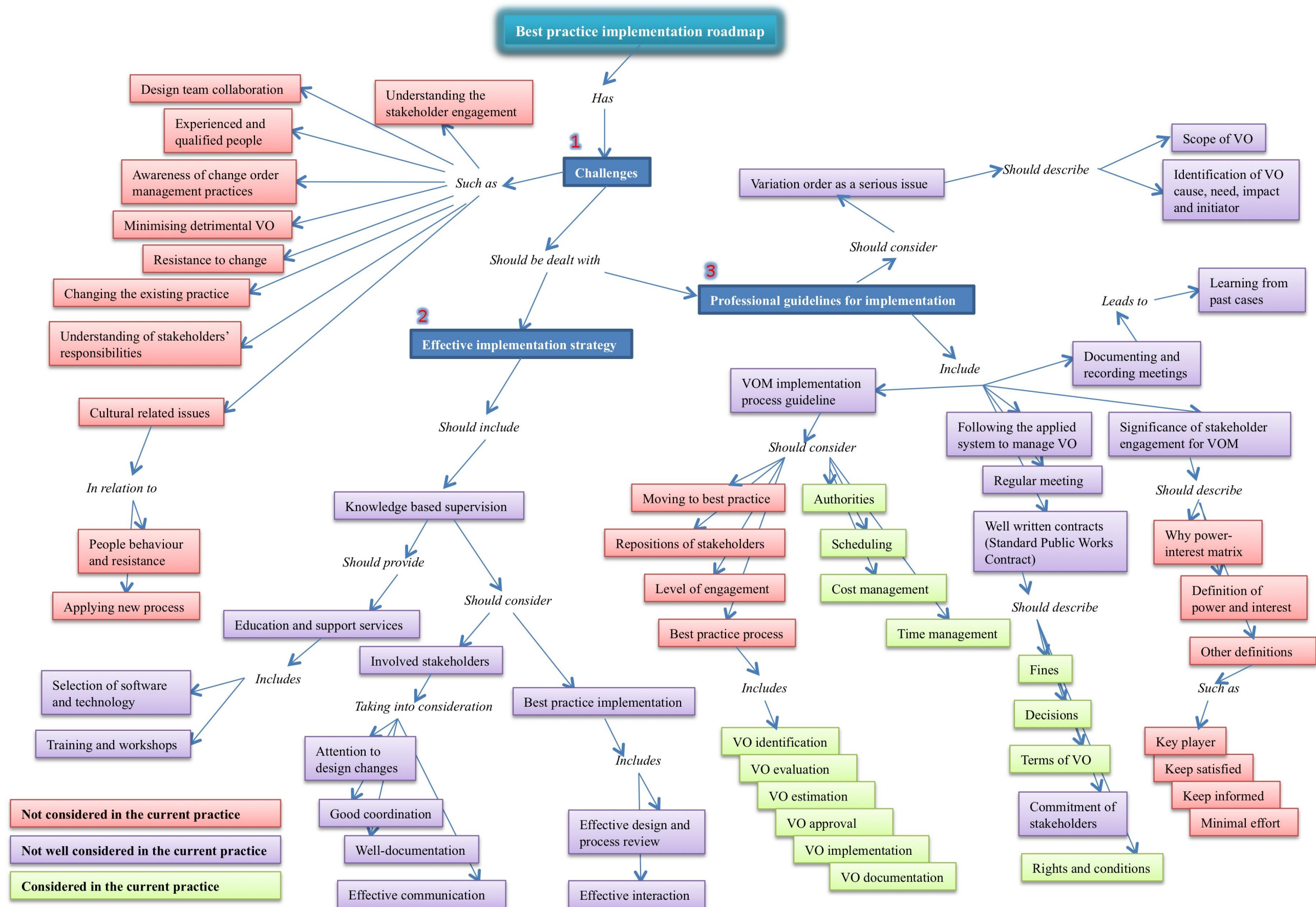


Figure 7-11 The best practice roadmap implementation

### ***7.7.1 Implementation of best practice of variation order management***

The findings from the exploratory interviews (see section 5.4), in conjunction with the thematic matrix (see Appendix C), emphasise the significance of effective communication, good coordination, good documentation and effective design review to better manage variation orders. In fact, these aspects are essential for good project management practices, not only in the context of this research. However, these aspects are particularly important in this research, which could be attributed to the fact that the current practice does not give enough attention to them, and also they are not yet properly established with regards to practices in variation order management (section 5.3.6).

In the context of this study, a certain level of communication and coordination is required to maintain a high performance workflow of the best practice to manage variation orders in the Saudi public construction industry. Maintaining the appropriate level of communication and coordination, would also lead to avoid unnecessary interactions by the stakeholders in order to save the time and cost from any obstruction in management of the change. Good documentation procedures assist public clients and consultants to learn lessons and build up their knowledge from the implemented variation orders, for future experience.

In the light of questionnaire findings, it is clear that there is a significant need for an efficient stakeholder engagement in the process of variation order management in the Saudi public construction projects. Furthermore, education, awareness and support services for change order management practices in general are critical to tackle the resistance to changing the existing condition to the best practice. In addition, the questionnaire findings demonstrate that sufficient understanding of the scope of the initiated variation order and guidance for the variation order management is essential to ensure successful implementation.

In adopting the best practice of variation order management in Saudi public construction projects, the research has identified three categories of key findings, based on the qualitative and quantitative surveys, to assist the public clients and design consultants to implement the roadmap effectively. The key issues and relevant aspects

from the developed matrices to better manage variation orders are explained in the following sections:

#### **7.7.1.1 Challenges identified in implementing best practice**

The possible challenges in implementing the matrices of the best practice for variation order management in the design stage in the Saudi public sector construction practice were identified from existing body of literature, the interviews and the questionnaire survey. Each type of challenge was classified into an action or activity step based on the challenge itself, as described in Table 7.1. This classification would provide a clear perception with which stakeholders could tackle the challenges and move forward to best practice, and is thus considered as the first priority in the roadmap.

**Table 7.1 The possible challenges for best practice implementation**

Challenge	Challenge type
<ul style="list-style-type: none"> <li>Overcoming the resistance to change, and getting the involved stakeholders to understand the potential value of the best practice</li> </ul>	Activity
<ul style="list-style-type: none"> <li>Training the public clients and design consultants in the best practice, or finding employees who have experience in change management</li> </ul>	Action
<ul style="list-style-type: none"> <li>The required collaboration, integration and interoperability between the design team and public clients</li> </ul>	Action
<ul style="list-style-type: none"> <li>Clear understanding of the responsibilities of different stakeholders and awareness of variation order management in the new process of variation order management</li> </ul>	Action
<ul style="list-style-type: none"> <li>Culturally related issues such as people's behavior and resistance to applying a new process</li> </ul>	Activity
<ul style="list-style-type: none"> <li>Sufficient terms and conditions in the public contracts with regards to variation order management</li> </ul>	Activity

To overcome the potential challenges identified in the roadmap, there is a need to provide training courses, workshops and specific support services, such as selection of software and technology, to those who deal with variation orders in the public sectors and consulting firms, to guarantee the highest efficiency for successful development and implementation of the proposed model.



### ***7.7.1.2 Need for an effective implementation strategy***

Implementing the integrated system for best practice of variation order management needs significant changes in the way construction businesses work at almost every stage within the variation order management process. In the qualitative and quantitative surveys the respondents highlighted that variation order management systems not only require an awareness of how they work out, but also who will apply them, how to train the involved engineers and assign responsibilities. It was clearly noticed that most public sectors and consulting firms in Saudi Arabia are grappling with the same fundamental issues of variation order management. The implementation strategy in the roadmap considers knowledge-based supervision as a key action in order to involve the stakeholders efficiently in the best practice process. This would assist the public client and design consultant to clearly identify the variation order in different terms, notably in terms of reviewing the disciplines affected in the design and checking that there were no design errors by the other disciplines after the variation order implementation. The complexity arises in multi-disciplinary design situations, because changes made in one discipline commonly impact design descriptions in other disciplines (Zaneldin, 2000).

In addition to that, an effective design and process review is considered as the second priority to effectively move to best practice of variation order management. This stage is a significant action to guarantee that there are no errors in the roadmap implementation. Therefore, it appears that the participants could all benefit from a clear set of professional guidelines and roadmap outlining a sufficient strategy to apply the best practice effectively in order to better manage variation orders.

### ***7.7.1.3 Need for professional guidelines on leveraging the best practice***

Integrating the stakeholder mapping with the basic principles of variation order management needs guidelines to facilitate its implementation. Going back to the findings in the constructed thematic matrix in Appendix (C), most of the participants stated that public clients and design consultants are still unaware of the significance of good implementation of variation order management systems to better manage variation orders in the design stage. This means that, these guidelines should take into consideration the exact responsibilities, authorities, repositioning of stakeholders and the method of interaction of each individual stakeholder to ensure the success of the integrated system of variation order management.

The guidelines include several key elements to enable the involved stakeholders to understand the successful implementation of the best practice. Furthermore, in this third priority of the roadmap category, the uniqueness of the roadmap being linked with the best practice of variation order management was taken into consideration. This can be described by explaining why the power-interest matrix is chosen to develop a best practice (section 5.10), what is the meaning of power and interest and how to move to best practice. Other key elements in the guidelines can be explained through the need for well-written contracts with regard to the variation order management terms and conditions. This action in the guidelines should be added in the Standard Public Works Contract (SPWC) of the Saudi public construction projects to ensure the successful implementation of the best practice of variation order management.

Moreover, arranging regular meetings and documenting the implemented variation orders are vital actions to follow up the process of variation order management. These professional guidelines would assist the involved stakeholders in understanding their roles and tasks, to avoid any potential conflicts and disputes. These elements in the guidelines would enable the stakeholders to move from the current practice to best practice. Additionally, would enable them to change their positions from stage to stage, based on the level of power and interest. Thus, there appears to be a need for providing professional guidelines to apply the best practice of variation order properly.

## **7.8 Reflection of the roadmap elements in the existing practice**

From the findings which emerged from the previous stages of the study, as presented in Figure 7.10, this second categorisation of the roadmap aims to enrich the analysis of the best practice model, in order to support the uniqueness of the roadmap and to understand which elements in the roadmap need more focus than others to assist the stakeholders to move to best practice effectively. In addition, this section aims to identify the most common obstacles that may face the application of the developed best practice model.

This categorisation divides the elements of the roadmap into three different sub-categorisations namely “*elements not taken into consideration in the current practice*”, “*elements not well considered in the current practice*” and “*elements taken into consideration in the existing practice*”.

### **7.8.1 *Elements not taken into consideration***

To guarantee the successful development and implementation of the proposed model for variation order management requires significant awareness of the newly established elements for best practice. This sub-section intends to determine which new elements in the designed roadmap are not yet well established in the current practice, resulting in deficiencies in the practice of variation order management. Clearly, particular attention to these elements is needed to successfully implement the integrated model of variation order management.

The elements identified arise from the basis of the power/interest matrix, the expected challenges that may negatively influence the application of best practice and potential problems with moving from the current practice to the developed best practice. In Figure 7.11, these elements are coloured in red, such as changing the existing practice, repositioning the stakeholders and definitions of power and interest in the context of the developed model.

### **7.8.2 *Elements not well considered in the current practice***

In order to support the success of best practice implementation and maintain efficient and continuing relationships among its stakeholders, some elements in the designed roadmap require more attention and improvements by the involved stakeholders. These elements attempt to develop a proper engagement technique and communication plan to ensure that the requirements and expectations of the key stakeholders are clearly understood and effectively managed, and also to evaluate the effectiveness of the communication plan to assist them to move to the best practice and avoid the current shortcomings.

The elements identified in this category come from the significant practices of projects management. In Figure 7.11, these elements are coloured in purple, such as *proper communication* to allow the project teams to ensure the timely implementation of the variation orders, *good documentation*, which is generally facilitated by designing an efficient change order system geared towards understanding the change order process, and can be collected from the standard forms of contract, and *learning lessons* from the implemented variation orders, to build up their knowledge for use in future experience.

### **7.8.3 Elements taken into consideration in the existing practice**

In order to guarantee continuing improvements in managing variation orders in Saudi public construction projects, the good practices in the existing condition should be retained. Here, the researcher seeks to include the good elements in the current practice in the designed roadmap and to shed more light on them to educate the key stakeholders about the positive issues in the current practice that should be retained to help them to move to the best practice.

The elements discovered in this category come from the basic principles of any variation order management system, as found in the exploratory interviews in chapter 5, which can be explained as *identify variation, evaluate and analyse, estimate, approval, implement and document variation order*. In Figure 7.11, these elements are coloured in green.

## **7.9 The respondent stakeholder to the best practice model**

Generally, the public client and design consultant have to work hand-in-hand to make sure the management of design changes is satisfactory and all the initiated changes are well implemented and documented. However, in order to guarantee a high performance workflow in managing variation orders, it is imperative to assign a responsible party to ensure that public client and design consultant are actively engaged to properly apply the best practice of variation order management. Leung and Olomolaiye (2010) argue that during the design stage, constant and frequent communication is vital. Furthermore, all the conflicts and technical issues between different types of project disciplines must to be resolved by the design consultants.

The design consultant is an important party to construction projects, as he/she is the responsible for delivering design quality that seeks the best potential satisfaction of clients' requirements and expectations, to avoid any potential design errors, poor implementation of variation orders and conflicts and disputes among stakeholders, in both the design stage itself and in subsequent stages. For that reason, the design consultant is advised to be the respondent and responsible stakeholder during the process of the management of variation orders to successfully implement variation orders. In addition, the design consultant is recommended to raise public client awareness and influence them to collaborate to properly implement the developed model. In contrast, the public client should give the design consultant sufficient time to

manage the process of the variation order management to achieve the maximum project performance.

### **7.10 Summary**

This chapter has presented the locations and positions of stakeholders in the power-interest matrix in each step for the best practice of variation order management in the Saudi public construction projects. Moreover, it has introduced the process of the integration of power-interest matrix for best practice of the variation order management system. This integration suggested a particular level of power and interest in each stage for the public client and consultant, to better manage variation orders. The principle behind this integration is the claim that a greater level of stakeholder engagement does not always mean greater success of variation order management. Hence, the integration requires an appropriate level of stakeholder engagement to lead to greater success of variation order management. Additionally, this chapter has explained the mechanism of repositioning the stakeholders in the power-interest matrix to better manage variation orders. Finally, a roadmap was provided to guide the involved stakeholders in the process of variation order management to implement the best practice effectively. The roadmap was categorised into three categories based on the priority of the key elements of the roadmap and, also was categorised based on the reflection of the roadmap elements in the existing practice.

## **Chapter 8 - Model validation and improvement**

### **8.1 Introduction**

This chapter is focused on testing the effectiveness, clarity, applicability and identifying improvements of the variation order management model developed in this study from the findings of the literature review and results of the exploratory interviews and questionnaires. In order to achieve the aim of this chapter an external validity assessment was carried out. The technique of the validity assessment was through two focus group workshops with thirteen practitioners from representatives of both public clients and design consulting firms in the Saudi construction industry. The data revealed was analysed statistically and qualitatively to achieve the aim of the chapter. The developed model was improved with two minor amendments, based on the results of this chapter. Additionally, an example of a typical variation order was managed through the final version of the best practice model, to illustrate how it works.

### **8.2 Validation Approach**

The validation concept depends on the view that the framework represents the real world, or part of it (Pidd, 2009). In addition, the validation approach needs to investigate if the model/framework behaves as the real world under the same conditions (Miser, 1993 and Pidd, 2009). According to Pidd (2009), the historical and social perspectives propose that a model becomes valid when it obtains acceptance by the experts in the same field. It can be argued here that there are no agreed criteria for the validation process, therefore validity judgments depend on the situation in which the developed model/framework is implemented and the phenomenon being modelled (Miser, 1993). Oberkamp and Trucano (2008) define validation as *“a process of determining the degree to which a model is an accurate representation of the real world from the perspective of the intended uses of the model”*.

The term “validation” means that the judgment is carried out by competent people or bodies (Church, 1983). The validation stage of the scientific method could be described as determining if the aim of the research has been achieved (Bock, 2001). In this research, the developed model was validated through a focus group workshop, and therefore, the validation approach was performed through seeking public clients and

consultants' judgment and feedback. Miser (1993) and Pidd (2009) argue that useful and realistic views of validation affirm the potential utilisation of models as the means of validation, which entails some researchers considering validation with regard to the practicality of use of the framework. In this respect, the technique of the validation workshop and the selection of contributors involved in making judgments and feedback play an essential task in obtaining utilitarian and pragmatic views.

### **8.3 External Validity**

Building a model for better variation order management based on limited views of participants from the previous stages of the study does not necessarily mean this model can be applicable and effective to all public sectors and consulting firms. Schwab (1999) asserts that researchers are always interested in generalizing the findings beyond the investigated cases. The motivation for carrying out a focus group workshop to validate the developed model is that experts involved in a mature practice may have insights that would not otherwise be available to the researcher. Thus, it is the quality of the insight that is imperative, rather than the number of participants who share it (Wainwright, 1997).

Whilst research studies that investigate a small number of cases may achieve good validity by providing a deep understanding of the practice in those cases, they have been widely criticized as lacking external validity (De Vaus, 2001). External validity refers to the generalization of the findings to or across target samples (Pedhazur and Schmelkin, 1991). Schwab (1999) affirms that there is no systematic or verifiable method to perform external validation based on a single investigation of a research relationship. However, the ultimate approach to assess the validity of the developed model would be to examine such principles in reality; but within research practice this is hardly possible (Pyett, 2003).

Testing the developed model by the application method, it could take several years before a fair judgment of the model's validity could be achieved. In fact, in this research this was considered difficult to obtain. However, several other techniques were available to maximize the validity of the model in this research as follows:

- Selecting experts in the field to be interviewed for the exploratory survey, which acts as a good representative sample of current practice.
- The survey provided a solid ground for understanding the current practice of variation order management; and therefore it was used as a guiding principle to develop the best practice model to suit the local construction industry.
- Designing a questionnaire survey to identify the level of power and interest of the public client and consultant during the process of variation order management to obtain the best practice.
- Developing the roadmap implementation strategy provided a basis for a viable best practice of variation order management system and guidance for its implementation.
- Seeking assessments of the effectiveness, clarity and applicability of the model in the construction industry by experts from public sectors and consulting firms.

#### **8.4 Model Validation: Aims and Objectives**

The aim of the validation exercise was to test the model's effectiveness, clarity and applicability to ensure that the developed model would add value to the Saudi public construction projects. The following objectives of the model validation were proposed:

- To discuss and test the findings and major issues which are presented in the model and their effects on the improvement of variation order management.
- To discuss and validate what success the experts think it would have.
- To discuss the barriers to the model implementation.
- To discuss how the model could be improved.

#### **8.5 Validation workshop sample**

It is advisable to keep the group as small as possible to allow the researcher to elicit the responses required. Albrecht *et al.*, (1993) suggest that the ideal number of participants per session should be between six and eight. In this study two sessions were carried out with six to eight participants for each session. The participants represented the both the public sector and consulting firms. Equally, eight from each stakeholder group were invited to attend the validation workshop. The participants of the two focus group workshops were not involved in the previous stages of the study. The reason behind that was because the model was developed based on the previous participants' thoughts and



views. Here the researcher sought to gain different perspectives from different participants, to ensure an effective validation process was obtained.

## **8.6 Validation technique**

A focus group workshop was carried out to get stakeholders' feedback and judgment about the research results. At this type of workshop, shared discussions between contributors was essential in capturing valued feedback in order to make sure that a practical and suitable model was developed. Ritchie and Lewis (2009) emphasise that focus group discussion allows participants to discuss their own views and experiences as well as hearing those of other people. In a similar manner, Kreuger and Casey (2000) affirm that the focus group workshop provides a more natural environment for sharing discussion and views rather than that of an individual interview, due to participants influencing and being influenced by others.

The focus group workshops concentrated on validating three key issues for the developed model: the model concept and whether it is applicable to be practices or not in Saudi public construction projects; the model performance during the change order management process and whether it is effective in engaging the involved stakeholders, and the model implementation strategy and whether it is sufficiently clear to be implemented successfully in the construction projects. All of these criteria aim to confirm the model applicability, effectiveness and clarity. The validation workshops consisted of four phases. These phases and the key issues of the validation workshop are described below:

1. A PowerPoint file was sent to each participant prior to the focus group workshop to provide a clear picture of the workshop contents, research methodology and findings, the process used to develop the model and the model implementation strategy. This phase aimed to make the participant understand and feel at ease (see Appendix (I) for the PowerPoint presentation).
2. The researcher provided a PowerPoint presentation for 25 minutes to the participants to provide a clear picture of the aim of the study. The presentation included the background of the research, the aims and objectives of the research, research methodology, data collection and findings and the process applied to develop the best practice model. The researcher presented the causes of the poor performance in the current practice, also how the proposed model is different

from the existing models of variation order management. Additionally, it was explained how the developed model can be implemented and worked out in the Saudi construction industry to better manage variation orders.

3. This phase lasted for one hour, to examine the model in depth, where the concept and mechanism of how the model works out were presented. It was explained why the research intends to manage variation orders by engaging the stakeholders through the power-interest matrix and how the level of power and interest would influence the proposed model to better manage variation orders. The researcher also explained the model performance by determining the positions and locations of the stakeholders and their responsibilities during the process of the model. Additionally, in this phase, the idea of the stakeholders repositioning from one stage to another was explained, and also the potential requirements and actions to assist the stakeholders to move from the current practice to best practice. Here, the benefits that the stakeholders would gain from implementing the proposed model were illustrated. Furthermore, the potential challenges and obstacles to the model application were explained to the participants and the solutions to overcome them. The suggested solution was by designing a roadmap implementation strategy to provide a solid basis to apply the best practice effectively. Then, open discussion led to acquisition of useful feedback and good judgment from the participants.
4. The last phase took about 25 minutes. Here, the participants were asked to rate their degree of agreement with the proposed model in terms of applicability, clarity and effectiveness. In addition, the participants were asked through open questions to express their opinions on the success they could gain from the model, the barriers they might face, the usefulness of changing the current practice to the proposed practice and the improvements they could add. More explanations were given to some participants to help them to understand the questions.

### **8.7 Design of the validation questions**

The focus group questionnaire consists of 11 questions and sub-questions (see Appendix F for the focus group questions). The questionnaire is divided into three main sections as follows:

- Section one was personal background, which was aimed to obtain information on the general particulars of the participants and their organisations, such as their positions in the design process within the organisation and years of experience.
- The second section of the focus group questionnaire used a seven point Likert scale. In these sections the respondents express the extent of their agreement on the model applicability, clarity and effectiveness by selecting the most appropriate answer such as 1= inapplicable, unclear and ineffective 7= applicable, clear and effective.
- The third section comprised open questions about the participants' opinions on the success and barriers of the model and how the model could be improved.

## 8.8 Validation participants

Thirteen participants representing the public sector and design consultants attended the two focus group workshops. Seven participants attended session one and six participants attended session two; each session lasted for two hours. The focus group sessions were held in a conference room at Le Jeddah Meridian Hotel (see Figure 8.1). For more details see Appendix E for the invitation letter, Appendix G for the hotel quotation for the conference room reservation and Appendix H for more pictures from Sessions 1 and 2.



**Figure 8-1 A picture from the focus group workshop (Session 1).**

Table 8.1 below explains the characteristics of participating experts in the both sessions in terms of their work organisations, positions and years of experience.

**Table 8.1 The characteristics of participating experts; PC is public client, DC is design consultant**

No:	Session	Participant	Work organisation	Position	Experience
1	1	DC1	Design consultant	Project manager	More than 20
2	1	DC2	Design consultant	Project manager	6-10
3	1	PC1	Public client	Architect	16-20
4	1	DC3	Design consultant	Project manager	More than 20
5	1	PC2	Public client	Design manager	More than 20
6	1	PC3	Public client	Project manager	16-20
7	1	DC4	Design consultant	General manager	More than 20
8	2	DC5	Design consultant	Architect	6-10
9	2	PC4	Public client	Project manager	11-15
10	2	DC6	Design consultant	Architect	6-10
11	2	PC5	Public client	Project manager	11-15
12	2	PC6	Public client	Architect	11-15
13	2	DC7	Design consultant	General manager	More than 20

## 8.9 Results of the focus group workshops

The questionnaire was explained to the thirteen participants clearly in the workshops. Hence, these responses were completed adequately for inclusion within the study. In the following sub-sections the respondents express the extent of their agreement on the model applicability, clarity and effectiveness. To do so, the mean was calculated for each criterion; also the weighted mean was calculated. These calculations give each response a specific weight reflecting its importance. Refer to section 6.9 for more details about the mean and weighted mean calculations.

### 8.9.1 Applicability of the model

Participants were asked in the workshops to rate the applicability for each of the model components, where 1 meant inapplicable and 7 applicable. The analysis of the answers

revealed that the levels of applicability for all criteria were considered far above the base.

In Table 8.2 below, the lowest mean value is 5.76 out of 7 for the actions required to move to best practice. Although its value does not indicate that the actions required are 100% applicable, it does show that it is more likely to be applicable than inapplicable. The results with regard to the model process, architecture of the model, the model design, the model achievability and the integration of power and interest are better, as they are all rated from 5.84 to 6.07 out of 7. However, the weighted mean for all the criteria is 6.

All the indications provide strong evidence that the criteria of the model are applicable in public construction projects in Saudi Arabia to better manage variation orders.

**Table 8.2 Applicability of the model components**

	Participants	Mean	Weighted mean
a) The model process	13	6.07	6
b) Architecture of the model	13	5.92	6
c) The model design	13	5.84	6
d) The model achievability	13	6.00	6
e) Integrating power and interest levels with variation order management	13	5.84	6
f) The actions required to move to best practice	13	5.76	6

### **8.9.2 Clarity of the model**

Participants were asked in the workshops to rate the model clarity for the criteria stated in Table (8.3), where 1 meant unclear and 7 clear. The analysis of the answers showed that the levels of clarity for all criteria were considered high.

In the table below, the lowest mean value is only 5.70 out of 7 for the stakeholders' positions during the process of the best practice. However, the value does not indicate that this criterion is not clear: it shows that it is more likely to be clear than unclear. The other criteria for the model clarity all scored from 5.76 to 6.15 out of 7. Here, the

weighted mean for determining the level of power and interest for the stakeholders is 7 out of 7 (to a great extent), and 6 out of 7 for the other criteria.

All the indications provide strong evidence that these criteria of the model are clear enough to be practised in public construction projects in Saudi Arabia to better manage variation orders.

**Table 8.3 Model clarity**

	Participants	Mean	Weighted mean
a) Stakeholders' responsibilities.	13	5.92	6
b) Determining the level of power and interest.	13	6.15	7
c) Communication method.	13	5.84	6
d) Stakeholders' positions.	13	5.70	6
e) Model requirements.	13	5.76	6

### **8.9.3 Effectiveness of the model**

Participants were asked to rate the effectiveness for each of the model components; where 1 meant ineffective and 7 effective. As shown in Table 8.4, the mean scores for effectiveness for all components are above 5.30 and range between 5.30 and 6.07. The analysis of the answers reveals that the levels of effectiveness for all criteria were considered high.

In the Table 8.4, the lowest mean value is 5.30 out of 7 for the effectiveness of the model outcomes. Although this value does not indicate that the outcomes of the model are 100% effective, it does show that it is more likely to be effective than ineffective. The scores for the other criteria for the effectiveness of the model are better, as they all scored from 5.70 to 6.07 out of 7. That means the weighted mean for all the criteria is 6.

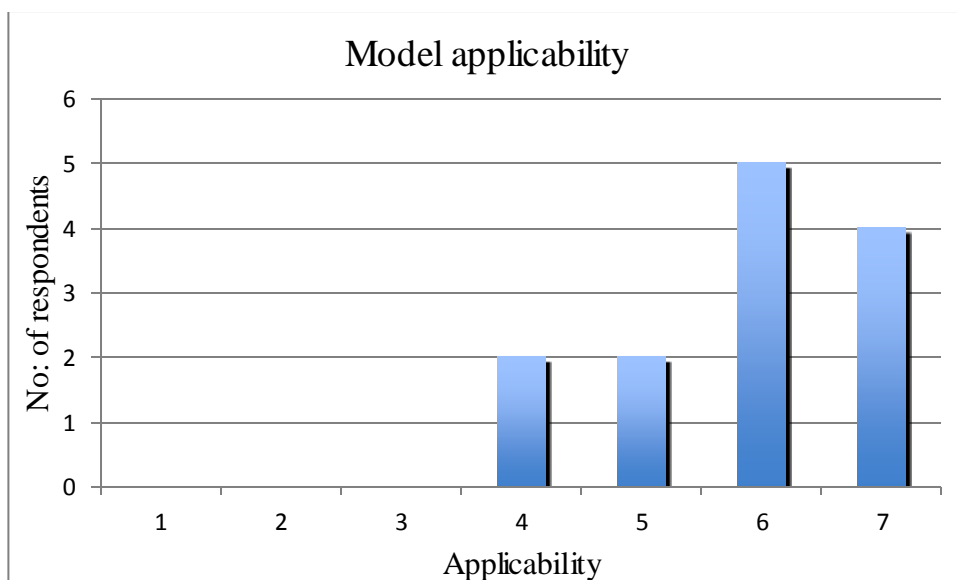
All the indicators together provide strong evidence that these criteria of the model will be effective when implemented in the Saudi public construction projects.

**Table 8.4 The effectiveness for each of the model criteria**

	Participants	Mean	Weighted mean
a) Reducing unnecessary interactions.	13	5.92	6
b) Method of relationship.	13	5.92	6
c) Avoiding conflicts and disputes.	13	5.70	6
d) Speeding up the process.	13	6.07	6
e) Outcomes of the model.	13	5.30	6

#### **8.9.4 Applicability, clarity and effectiveness of the entire model**

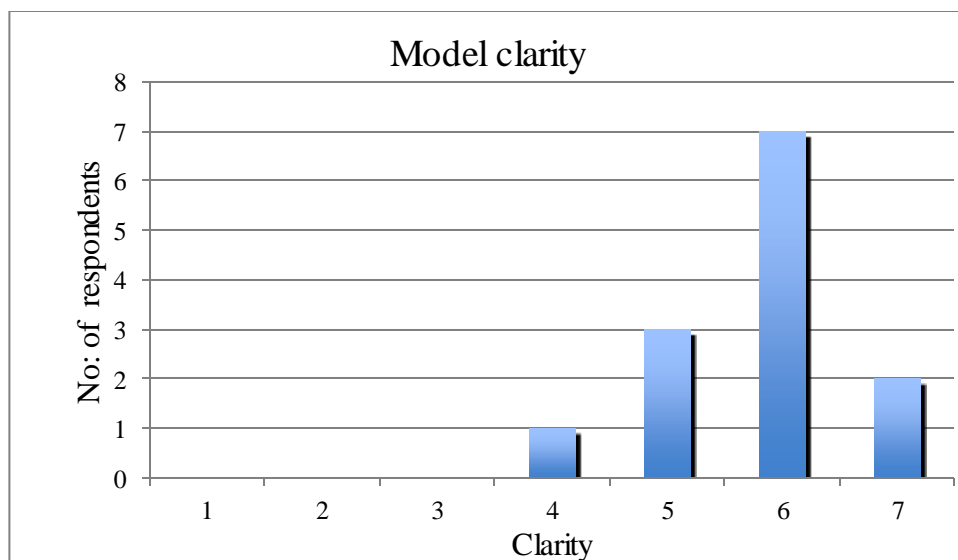
Participants were asked to indicate their rate of applicability for the entire model, using the same criteria as those mentioned above. As shown in Table 8.5, the mean value of the applicability is 5.84 and the weighted mean is 6. In addition, the histogram in Figure 8.2 shows that only 2 of the experts rated the applicability of the entire model as low as 4. Therefore, the indications of the model applicability are positive and reveal that this model is considered applicable to be practised in the Saudi public construction projects.

**Figure 8-2 The frequency of applicability ratings for the entire model**

**Table 8.5 The ratings of applicability, clarity and effectiveness for the entire model**

	Participants	Mean	Weighted mean
a) Applicability.	13	5.84	6
b) Clarity.	13	5.76	6
c) Effectiveness.	13	5.70	6

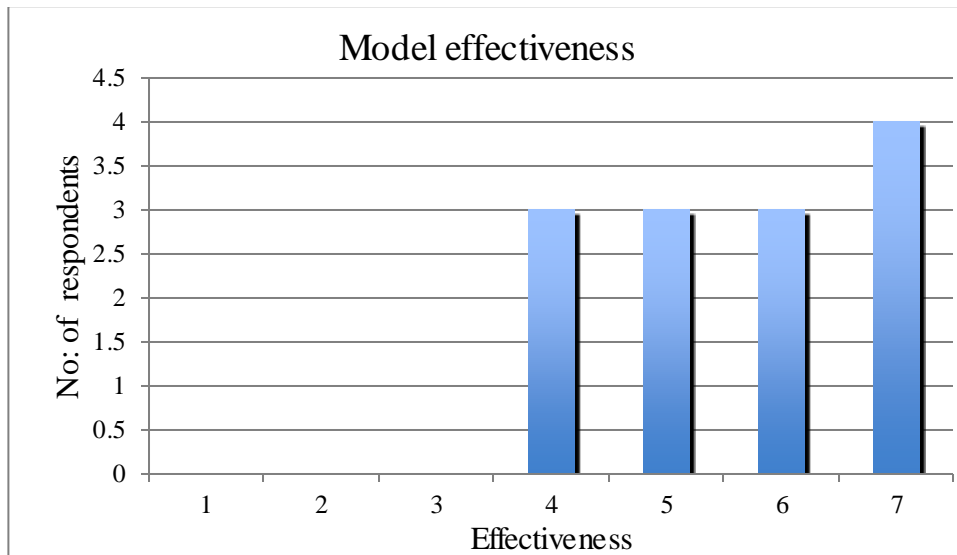
Following that, the participants indicated their rate of clarity for the entire model. Table 8.5 demonstrates that the mean value of the clarity is 5.76 and the weighted mean is 6. Moreover, the histogram in Figure 8.3 shows that only 1 respondent rated the clarity of the entire model as 4 and the others gave a rating of 5 and above. As a result, the indicators of the model clarity are positive and show that this model is considered clear enough to be implemented in the Saudi public construction projects to better manage variation orders in the design stage.



**Figure 8-3 The frequency of clarity ratings for the entire model**

Finally in this section, the participants rated the effectiveness of the entire model. Table 8.3 shows that, the mean value of the effectiveness is 5.70 and the weighted mean is 6. Additionally, the histogram in Figure 8.4 below shows that 3 participants rate the effectiveness of the entire model as 4 and the others gave a rating of 5 and above. As a result, the indicators of the model's effectiveness are positive and show that this model is considered effective to be implemented in the Saudi public construction projects.





**Figure 8-4 The frequency of effectiveness ratings for the entire model**

## 8.10 Open evaluation

Experts were asked to express their opinion about the model in terms of successes, barriers and possible improvements. These questions could provide further assessments not fully covered in the closed questions. Thirteen feedback comments were received from the participants. Different themes and concepts emerged from the analysis of the responses. These themes and concepts were categorized based on the challenges of application of the model and implications of the developed model.

### 8.10.1 Successes of the model application

Different themes emerged from this question, these themes were categorized based on the potential implications of the model (refer to section 7.4). These themes were as follows:

- ***Improving the quality of variation order management practices***
  - DC1 states, *“Personally, I think this model would improve the level of quality for the design process”*. Also, he asserts, *“this model would lead to better design outcomes as it pays attention to the shortages in the current practice and engages the stakeholders to work closely”*.
  - DC3 says, *“I can assume that the developed model would highly improve the quality of the project specifications and the contract terms with regards to variation order management because this model encourages*

*the stakeholders to well identify and document variation orders”.*

- PC3 believes that, *“The model seems a highly advanced one, it would improve the workflow of the entire design process as this model identifies the variation order effectively from the early stages of the variation order management”.* Additionally, PC3 thinks, *“this model would reduce the potential errors of the variation order cost and time estimations, also would reduce the design errors because of the good variation order management and implementation”.*
- DC5 states, *“Generally speaking, this model will be extremely effective and the clients and consultants will gain better quality of the design process and variation order implementation by knowing their positions in the model’s process”.*
- PC4 believes that, *“the clarity and ease of the model will lead to positive influence to implement and manage the variation orders in the design stage”.*
- DC6 is sure that, *“this model will minimize the errors of the design in the subsequent stages as it will lead to good practice of the variation order management”.*
- PC6 says, *“This model will help the stakeholders to identify and evaluate the aim of the variation order, which will add value to the design”.* Moreover, he states, *“it gives the chance to the design consultant to analyse, evaluate and implement variation orders efficiently”.* Finally, PC6 believes that, *“the clarity of the model process will assist the stakeholders to get best practice of variation order management”.*

The above comments by the experts indicate that, the developed model will improve the design quality of the Saudi public construction projects. Additionally, it will improve the workflow of the variation order process to obtain the highest efficiency for better management of variation orders. These indications add weight to one of the identified implications of the model, which states this model would improve the design quality with regards to variation order management in section 7.4.

- ***Clarifying the stakeholders' responsibilities***

- DC2 states that, *"I can say that, this model identifies the responsibilities of the public client and design consultant clearly, which will be reflected positively in the variation order management to obtain the best practice. Also, identifying the level of power and interest for both stakeholders helps them to understand their tasks"*.
- DC5 emphasises that, *"the clarity of the stakeholders' positions during the process of the best practice model will greatly assist them to do their tasks without any unexpected interactions which can negatively affect the proper implementation of the variation order"*.
- PC5 says, *"I believe that, this model integrates the stakeholder management and the variation order management practices in an easy way that enables the involved stakeholders to understand their responsibilities to manage variation orders successfully"*.

The above statements by the participants signify that, the developed model will identify the stakeholders' responsibilities effectively which will lead to better understanding of the variation order management practices. Furthermore, the developed model will enable the stakeholders to do their tasks without any unexpected interactions that can lead to poor management of the variation orders. These statements support another implication of the model, which states this model would clarify and determine the stakeholders' responsibilities during the variation order management process. See section 7.4.

- ***Reducing the quantity of the unnecessary interactions***

- PC4 affirms that, *"One of the advantages this model helps the stakeholders to avoid the unnecessary interactions during the stages of the model as their tasks are clear enough to manage the variation order which definitely will improve the existing condition"*.

The above statement by PC4 signifies that the model will assist the public client and design consultant to maintain a high performance workflow to avoid unnecessary interactions by the stakeholders to gain greater success of variation order management.

This statement adds weight to another implication of the model, which states this model would reduce the quantity of the unnecessary interactions by public clients during managing and implementing the variation order. See section 7.4.

- ***Improving the communication and relationships***

- PC2 states, *“I do believe that this model will provide a better picture of the relationship among the stakeholders during the process of the variation order management to obtain the best practice. This can be because their positions and locations are clear as well as the method of communication”*.
- DC4 says, similarly to the above statement: *“determining the position of each party in each stage will improve the relationship between the stakeholders in the model, which will definitely lead to maintaining a professional reputation for the public clients and design consultants”*.

The above comments by the experts PC2 and DC4 indicate that the developed model will improve the relationship and communication of the stakeholders during the process of the variation order management. This could be due to the fact that, this model determines the appropriate level of stakeholder engagement for best practice. In addition, the experts affirm that, the clarity of the relationship in the developed model will provide a better picture of how communication should be practised among the stakeholders. This indication adds further support to one of the identified implications of the model, which states that this model would improve the communication and relationships among the stakeholders in section 7.4.

- ***Avoiding conflicts and disputes***

- DC1 believes that, *“if this model has been practiced as it was designed, I can say that it will minimize the associated problems with the variation order management”*.
- PC1 is sure that, *“minimizing the potential disputes and conflicts between the public client and design consultant is one of the advantages of the model”*.

- PC6 says, similarly to the above comment *“disputes and conflicts can be avoided by applying the developed model. Also, the documentation stage will reserve the stakeholders’ rights from any unexpected claims in the future”*

The above statements by the participants signify that, the developed model will minimize the disputes and conflicts among the stakeholders that occur in the existing condition due to the poor practice of variation order management. This issue could be attributed to the fact that the developed model determines the responsibilities and roles of the involved stakeholders, which can assist the stakeholders to overcome disputes and conflicts. These statements add further support to one of the implications of the model that states this model would assist the stakeholders to avoid conflicts and disputes during managing and implementing variation orders as the positions of the stakeholders are clear. See section 7.4.

- ***Speeding up the process***

- PC1 emphasises that, *“From my point of view, this model will save variation order management time. This because the model overcomes the unneeded interactions that can affect the management time”*.
- In a similar manner PC2 thinks that, *“identifying the level of power and interest before initiating the variation orders will help the involved stakeholders to save the variation order implementation time”*.
- Similarly to the above comments, DC4 says, *“the integration of stakeholder engagement and the variation order management process will provide a best practice that can save the design process time”*.
- Further support was given by PC6, *“practising the model will minimize the possibility of the design delay in future projects due to the variation orders. Also, the performance of variation order management practices will increase, due to the experience gained and knowledge from the previous variation orders”*.

The above statements confirm that, the developed model will maintain a high performance workflow to avoid unnecessary interactions by the stakeholders to save the

time of variation order management. In addition, the application of the model will improve the performance of variation order management in future cases, due to the experience and knowledge gained from practising the model. These statements were mentioned in the potential implications of the model application in the Saudi public construction industry in section 7.4.

- **General comments**

- DC1 states that, *“In my personal opinion, this model will save the design cost because this model will reduce the willingness to initiate the variation orders by the public client. This issue can be because the developed model identifies the positions of the stakeholders effectively”*.
- DC3 says that, *“I strongly believe that, applying this model will improve the performance of the design stage by minimizing the occurrence of variation orders in the future projects due to the client and consultant having learnt lessons, by documenting the variation orders from their previous cases”*.
- DC4 emphasises that, *“As a design consultant, this model will help to minimise the possibility of consultants’ bankruptcy, because there is no formalised approach in the current practice to manage variation orders and the lack of good documentation”*.
- PC5 believes that, *“I can say that this model will come out with some beneficial knowledge that can add value to the project management practices in the Saudi construction industry”*.

Some of the above points were not taken into consideration while developing the model. However, they may be good points which can add extra weight to the success of the model.

#### **8.10.2 Barriers to the model application**

It is assumed that it is hardly possible to apply a new method without any obstacles. Therefore, different themes emerged regarding the potential barriers of the model application. These themes were categorized based on the challenges identified in implementing best practice. (Refer to section 7.7.1). These themes were as follows:

- ***Understanding the stakeholder engagement practices***

- PC4 affirms that, *“it seems to me, it will not be easy to convince the public client that his interactions or participations in some stages of the model are not beneficial to the process of the variation order management and can cause delays or poor management of the variation order”*.
- DC6 believes that, *“I expect some failures to allow the design consultant to complete his/her tasks efficiently due to, in some cases, the public client imposing his views, whether he is right or not”*.

Poor stakeholder engagement in the process of variation order management is one of the challenges to the best practice, as the above statements indicate. This challenge was mentioned in the best practice roadmap implementation (see section 7.1.1).

- ***Design team collaboration***

- PC2 asserts that, *“lack of response from the stakeholders with regard to the model requirements and processes will be one of the barriers for the effective model application. From my experience, some stakeholders do not pay enough attention to the importance of design team collaboration to solve the design problems”*.

The above statement by the participant suggests that poor design team collaboration is considered as an obstacle to the application of the best practice. The researcher is aware of this challenge, as it can influence the success of the variation order management. Thus, this challenge was mentioned in the roadmap implementation to encourage the stakeholders to pay attention to it.

- ***Experienced and qualified people***

- DC4 states that, *“the Saudi construction industry suffers from shortages in training courses and professional workshops for the architects and*

*engineers in the design stage. This issue needs to be overcome for the success of the model application”.*

- PC5 says that, *“weakness in making decisions for some public clients’ representatives due to the bureaucracy and fear of responsibility can be a major barrier for the model application”.*
- PC6 asserts that, *“the model as a concept is great, however the stakeholders need to have time to understand the stakeholder engagement practices in the construction industry, then they can be equipped to practice the developed model properly”.*

The above comments by the expert DC4, PC5 and PC6 indicate that inexperienced and unqualified people can be a severe obstacle for the proper implementation of the best practice. An expert emphasises that firstly, the public clients and design consultants need to understand the significance of stakeholder engagement during the all activities of a construction project. Then, the stakeholders have to be qualified enough to practise the stakeholder mapping in the process of variation order management. These obstacles were taken into consideration to draw to the stakeholders’ attention. Hence, stakeholders can overcome this issue by improving their work skills, holding or attending training courses and hiring professional engineers.

- ***Awareness of change order management practices***

- DC1 believes that, *“stakeholders’ awareness is not enough yet to establish such a model that identifies their positions and responsibilities to manage variation orders”.*
- DC6 emphasises that, *“not having clear terms and conditions in the current public contracts that explain the practice of the variation order management will be a drawback for the successful implementation of the developed model”.*

The above statements point out that lack of awareness of change order management practice is an expected challenge that may face the best practice. This challenge could be attributed to the fact that there are insufficient terms and conditions for practising variation order management in the current form of the public contract, as mentioned



earlier in the roadmap implementation strategy in section 7.1.1. Thus, a well-written contract is a must tackle this challenge and assist the stakeholders to move forward to best practice to better manage variation orders.

- ***Resistance to changing the current practice***

- DC4 says, *“Resistance to change the current practice by the stakeholders may affect the success of the best practice model”*.
- Similarly to the above comment, DC6 says, *“From my personal experience, the developed model will face resistance to change the existing condition in the public sectors and consulting firms”*.

Resistance to change is a potential obstacle that can negatively influence the model application, for different reasons, such as lack of experience. Stakeholders should understand the significance of implementing such a system that helps them to better manage variation orders.

- ***Culturally related issues***

- DC3 thinks that, *“cultural issues and people’s behaviour can be barriers for the model application”*.
- Further support by DC6, *“conflict of interest for some clients’ representatives or even design consultants whether to initiate/ approve a variation order or not. This can be an issue to the model application as the model determines the level of power and interest for each stakeholder”*.

As the participants state, culturally related issues and people’s behaviour can be barriers for the model application. These barriers were taken into consideration in the roadmap implementation strategy in order to facilitate the efficient working out of the model.

### ***8.10.3 Model Improvement***

Another question that was asked was related to how the model could be improved. The list below illustrates the feedback received from the participants.

- DC1: *“determining the problems and limitations of the study clearly”*.
- DC2: *“more clarity about the benefits that can be gained from the model application. Also, clearer presentation of the model”*.
- DC3, DC5, PC1 and PC4: *“increasing the level of interest for the design consultant to be a key player in the analysis and evaluation stage to enable the designer to analyze and evaluate the variation order efficiently”*.
- PC2: *“show an example of how the model will work out in practice”*.
- PC3: *“improvements come after the model application to find out the advantages and disadvantages of the developed system”*.
- DC4: *“expanding the model limitations to cover the construction phase and involve the contractor in the study”*.
- DC5: *“time scale and profitability should be addressed in the model process”*.
- PC4: *“the model presentation should be improved to be clearer and easy to understand for the public clients and design consultants”*.
- PC4, PC6, DC6 and DC7: *“increasing the level of interest for the public client in the documentation stage to encourage the public client to pay more attention to well-documenting variation orders”*.
- DC6: *“These kinds of studies can always be improved and there is no such thing as the perfect variation order management. However, this model is excellent for understanding the needs and requirements of stakeholders in this age to manage variation orders in the Saudi public construction industry”*.
- PC5: *“engaging the contractor in the model to manage the variation orders in the construction stage”*.
- DC7: *“linking the developed model with the IT system which facilitates the process of the model and inserts information in a data-base and documents all variation orders”*.

The answers of the participants can be categorized into four main groups:

Firstly, improvement is a continuous process and the most proper way to improve the model is through application. However, testing the developed model by the application method, it could take several years before fair judgment of the model's validity could be achieved.

Secondly, improvement can be achieved by addressing the limitations, implications and requirements, which have already been addressed in this study. These significant factors proclaim the importance of the best practice of variation order management.

Thirdly, linking the developed model with the IT system and involving the contractor in the model, which is out of the scope of the study. However, these suggestions can be taken into consideration in future research studies.

Finally, increasing the level of interest for the stakeholders and changing their positions in some stages of the developed model were taken into consideration. These changes were added to the model and more details are given in the next section.

### **8.11 Model development and discussion**

In this session, the model, the model's requirements and the actions that need to be taken place to move to the best practice were explained to the participants. The results of the focus group workshops provided extensive feedback on the model. Hence, in order to facilitate the analysis of the model development, the responses were recorded and transcribed. Generally, the outcomes of the validation workshop were very positive from the participants; also, they were agreed on the entire process of the model and the requirements. However, the participants forwarded some recommendations which are two minor changes to the stakeholders' power and interest levels during the process of the developed model for variation order management to make it more efficient, notably in the analysis and evaluation stage and documentation stage. These changes did not affect the process of the entire model and the other stages will remain as they are. Refer to section 7.3 for more details about the other stages, namely variation order identification, variation order estimation, variation order approval and variation order implementation.

The first recommendation was about the location of the design consultant in the variation order analysis and evaluation stage, which is the second stage of the proposed model. According to the participants, to assure that this stage is well analyzed and evaluated, the interest of the design consultant should be increased to be high and the power level should remain at the high level. This means, the location of the design consultant in this stage should be changed from keeping him/her satisfied to be the key

player of this stage. When this happens, this will lead the design consultant to be a key player and will enable him/her to have the required data and enough time to analyse and evaluate the variation order efficiently. In this stage, the design consultant is considered as the main player responsible for the outcomes of the variation order as well as with the final outcomes of the variation order management and implementation. Hence, the participants highly recommend that the design consultant should have a high level of power and interest. Clearly the acceptability of decisions in this step to the consultant is a major consideration when analysing and evaluating the variation order.

In addition, they recommend the public client should retain his position to be kept informed about the results of this stage by the design consultant. Moreover, the public client must let the consultant work in this stage as a key player without any unnecessary interactions that can affect the progress of this stage, in order to manage the variation order cost and time effectively.

The second recommendation was about the location of the public client in the variation order documentation stage, which is the last stage of the proposed model. The results from the focus group sessions were that the interest of the public client should be increased to be high and the power level should remain at the low level. This means the design consultant should keep the public client informed about the variation order documentation process to reserve their rights from any unexpected future claims. According to the participants, the additional reason for increasing the level of interest for the public client is to pay more attention to well-documenting variation orders, as this is a significant stage in the process of variation order management. This will assist the public client and design consultant to learn lessons and build up their knowledge from the implemented variation orders for future experience to manage variation orders properly. The public client is recommended to work closely to the design consultants to guarantee the highest efficiency in archiving and documenting variation orders, to move to best practice of variation order management.

On the other hand, the participants recommend the design consultant should retain his/her position as a key player of this stage. However, the consultant should inform the client about the documentation process and provide him with the final documents of the variation order. In this stage, good documentation would help the stakeholders to

minimize the potential variation orders in the future construction projects, due to the lessons learned from the previous variation orders.

Figure 8.5 presents the final version of the model after implementing the amendments recommended by the focus group participants. Changes were focused mainly on the locations of the design consultant in the second stage and the public client in the last stage. The participants were highly agreed on the other locations and the levels of power and interest for the stakeholders during the process of variation order management.

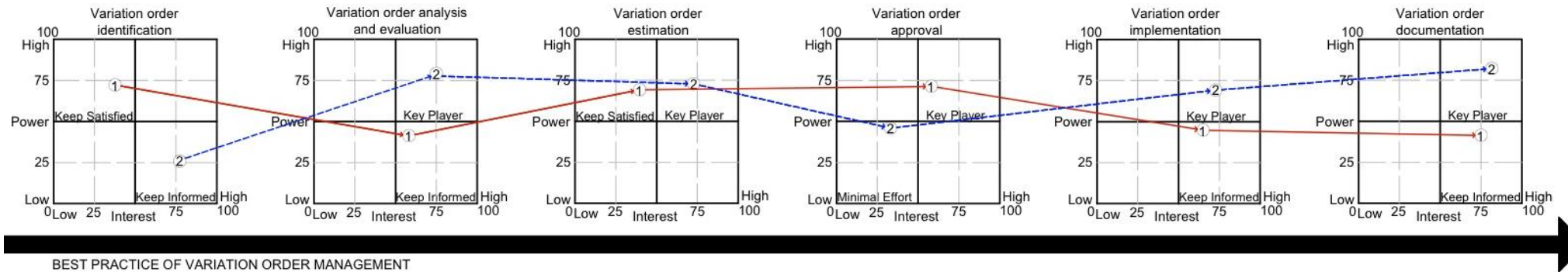


Figure 8-5 The final version of the variation order management model: 1 represents the public client, 2 represents the consultant.

Summary of the key differences for the developed model before and after validation:

- **Variation order analysis and evaluation stage:** The level of interest for the design consultant was increased.
- **Variation order documentation stage:** The level of interest for the public client was increased.

### 8.11.1 An example of a typical variation order

The researcher could not test the developed model through model application in a real life variation order in the design stage to assess how it will perform in a real construction project, due to the limited resources, time constraints and difficulty to get approval from all the involved stakeholders to test the model. However, the model was tested through experts in the Saudi construction industry. Additionally, this section presents one normal way of managing a typical variation order through the model application as an example to illustrate how the model works out in the design stage to effectively manage variation orders. Here, the design will be explained followed by the variation order and its management. The example is a two-floor office building, adapted from Zaneldin (2000). The ground floor of this building consists of a conference room, three offices and a toilet. Each of these spaces includes different elements such as walls, doors, windows, slabs, columns and beams, etc. At the beginning of the detailed design stage, some of the architectural and structural details for the ground floor are presented in Figures 8.6 and 8.7. In this stage, the architect was satisfied with the dimensions of the ground floor. The structural system of the office building was designed using solid concrete slabs supported by concrete columns and beams. To the architect, the proposed structural system was acceptable as all structural components are flush with the walls, which serves the architectural needs of the building.

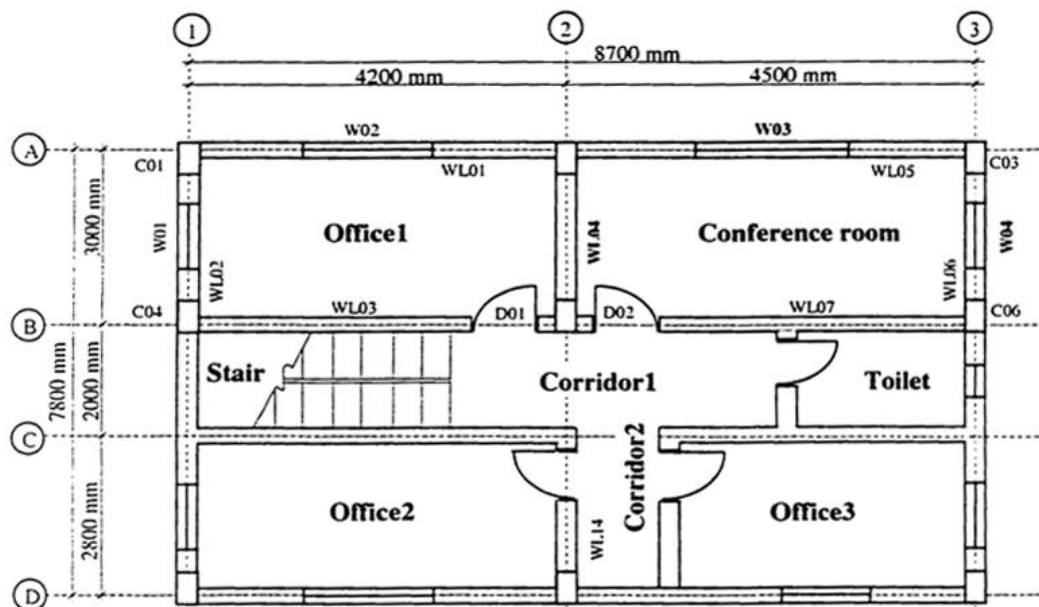
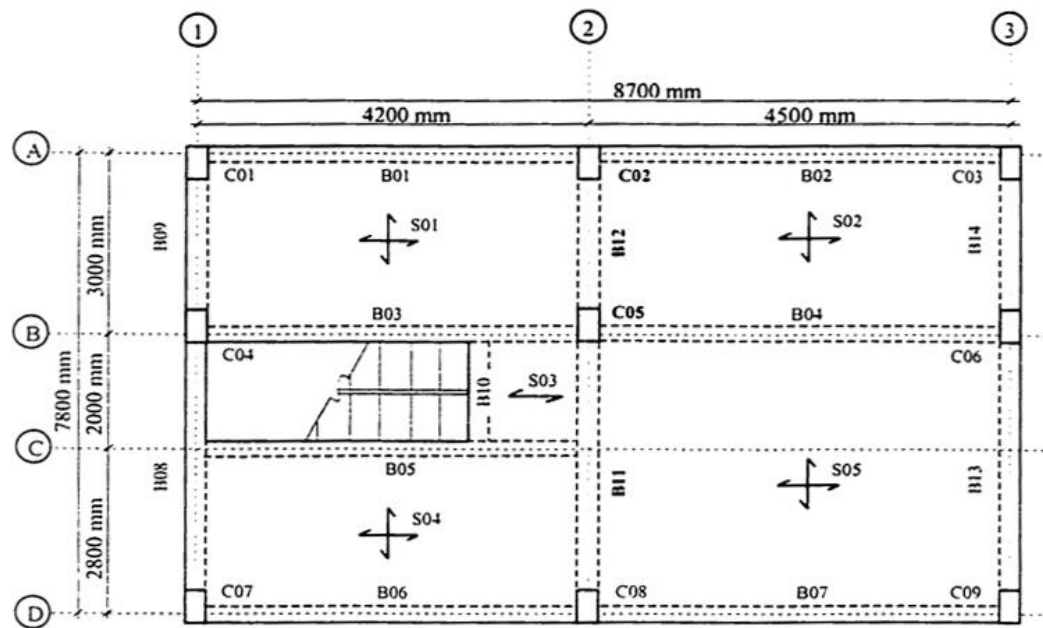


Figure 8-6 The architectural design of the office building

At this stage of the design, the public client initiated one typical variation order. The client decided to slightly change some of the dimensions in the ground floor, to enlarge the conference room by 20 cm and also to shorten the office (1) by only 20 cm.



**Figure 8-7 The structural design of the office building**

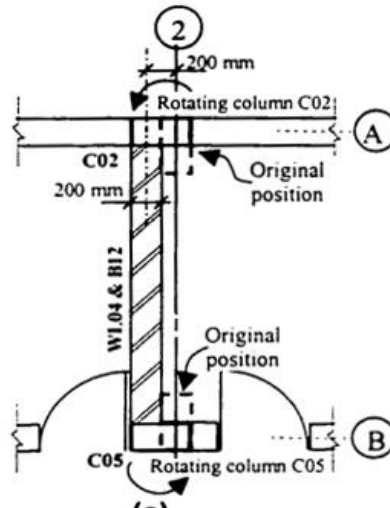
With this typical variation order, some processes were undertaken to implement and manage the proposed variation order. This variation order was managed through the developed model in this study, as follows:

- The design consultant identified the proposed variation order as changing some dimensions of the ground floor to enlarge the conference room and shorten office (1). The client was the source of this variation order, as he wanted to get more space for the conference room to fit with its needs. In this stage of the variation order management, the public client provided the consultant with all required information, such as the aim and scope of the change. The provided information that kept the design consultant fully informed to assist him/her to identify the variation order effectively. The design consultant classified the type of the variation order as architectural and structural change. Moreover, the electrical and mechanical engineers checked the HVAC design and lighting design for the conference room and office (1) for any possible changes. Meanwhile, the design consultant kept the public client satisfied about the identification of the variation order type and the potential impact of it on the



design. Here, keeping the design consultant informed and public client satisfied helped to move forward to the second stage without any delay.

- In the analysis and evaluation stage, the design consultant considered this variation order as a simple change that can be implemented by rotating column C02 and column C05 and shifting beam B12 by 20 cm (see Figure 8.8).



**Figure 8-8 The proposed solution for the variation order**

These changes to the plan of the conference room and office (1) required an architectural redesign of door D01 for office (1), window W03 for the conference room and window W02 for office (1). No changes were required for the HVAC; however, some changes to the lighting designs were required for the conference room and office (1). The design consultant evaluated this variation order as a positive variation order that can meet the client's requirements without any significant changes to the design. In this stage the design consultant educated the public client and kept him informed about the outcomes of the variation order analysis and evaluation. On the other hand, the design consultant was the key player of this stage. No unnecessary interactions happened in this stage, which helped the designer to analyse and evaluate the variation order efficiently. This led to timely evaluation of the variation order and smoothly moving to the next stage.

- In the third stage of the developed model, variation order estimation, the design consultant carried out a study to determine the cost and time to implement the proposed variation order in the design stage and construction stage based on the analysis of the variation order. Here, the consultant was the key player of this

stage and that enabled him/her to estimate the cost and time implementation of the proposed variation order properly, without any interventions by the client. The design consultant tried to keep the public client satisfied with the variation order estimation. Making the client satisfied with the cost and time estimation without any negotiation or rejection assisted them to move ahead in a timely fashion for the next stage, as planned for the variation order implementation.

- In the approval stage of the variation order, the public client reviewed the variation order against the project scope and checked whether the cost and time of the variation order implementation were acceptable or not. Then, the public client approved the variation order based on the variation order estimation stage. The acceptability of decisions in this stage between the public client and design consultant was a major cause to go ahead to the variation order implementation stage without any conflicts or disputes among them.
- The design consultant implemented the proposed variation order after reviewing the affected disciplines in the design and checked there were no design errors by the other disciplines after the variation order implementation. The design consultant was a key player in this stage, which greatly assisted him/her to track the variation order for the timely implementation. The design consultant kept the public client informed about the process of the variation order implementation and the disciplines affected by the variation order. Keeping the client informed in this stage helped him to understand the different changes that happened to the design.
- In the final stage of the developed model, the design consultant was the main player responsible for documenting and archiving the variation order. The design consultant made some notes to learn lessons from this variation order and build up his/her knowledge from the implemented variation order for future experience. The design consultant kept the public client informed about the lessons revealed from the variation order and handed him a copy of the documentation for the proposed variation order, to reserve their rights from any unexpected future claims.

The model application through the proposed variation order, which was the increase in the conference room length, assisted the public client and design consultant to determine their responsibilities and positions during the process of managing the variation order. In addition, the model application assisted the design consultant to work

without any unneeded interactions that could affect the progress of the variation order management. These factors were also a cause of not having conflicts or disputes, as the tasks of the stakeholders were determined before starting to manage the variation order. In addition, the good documentation would help them to minimize the potential variation orders in the next construction projects due to the lessons learned from this example.

### **8.12 Summary**

This chapter aimed to determine the validity of the best practice variation order management model. This was done by testing the effectiveness, clarity and applicability of the developed model. Moreover, the advantages and disadvantages of the model application and the model improvements were identified, through two focus group sessions. Thirteen experts participated in these two focus group sessions. The overall feedback was mainly positive and the comments were considered in the model improvement. All participants expressed their opinions that it was feasible to practise this model in the field and expected that there would be tangible benefits from it. In the analysis of the feedback, the model was found to be applicable, effective and relatively clear to be applied in the Saudi public construction industry. However, two minor changes to the stakeholders' positions in the model were performed, based on the participants' suggestions. This chapter then presented the final version of the model after the recommended amendments. Finally, this chapter presented one example of a normal way of managing a typical variation order through application of the model.

## **Chapter 9 – Conclusions and recommendations**

### **9.1 Introduction**

The aim of this research has been to develop a model which, if it was applied, would improve the practice of variation order management in the Saudi public construction projects at the design stage by determining the stakeholders' responsibilities, positions, tasks and the method of engagement and communication to effectively engage stakeholders and better manage variation orders. This aim has been achieved through the completion of the five stages detailed in the thesis, namely literature review, exploratory interviews, questionnaires, model development and focus group workshops. This chapter intends to summarise the development of the study and concentrates on the key findings. In this chapter, the researcher concludes the research and describes the findings gained in terms of the research objectives. Additionally, it highlights the contribution to knowledge in the field of the research. Finally, it shows the research limitations and makes some recommendations for future research.

### **9.2 Model development**

The aim of this research is to develop a model that better manages variation orders in the Saudi public construction projects in the design stage. This better management was achieved by identifying the optimum level of engagement in the design stage to improve the engagement of stakeholders in the process of the variation order management, to save time, improve the communication and relationships among stakeholders and so avoid disputes and conflicts. These aspects were considered highly important to improve the practice of variation order management, due to the lack of understanding of their significance in the current practice, which has led to poor variation order management (see section 5.5). The model structure comprises two different systems, namely the basic principles of variation order management model and the stakeholder power-interest matrix, to gain the results required for best practice of variation order management in the Saudi construction industry. Additionally, the developed model sets out the research question (section 1.2): how can the management of variation order be improved in the Saudi public construction projects and how can the stakeholders be better engaged to improve communication and relationship among stakeholders and avoid disputes and conflicts and thus speed up the process?

### **9.2.1 Basic principles of variation order management**

The basic principles of any system to manage variation orders is to anticipate, recognize, evaluate, resolve, control, document and learn from past variation orders. Arain and Pheng (2007) propose six basic principles to manage variation orders effectively. These principles are adopted from CII (1994b). The six basic principles are: *identify variation for promoting a balanced variation culture; recognize variation; diagnosis of variation; implement variation; implement controlling strategies; and learning from past experience*. Following the same line of thought, the exploratory stage of this study proved that the current practice in the Saudi construction industry (section 5.6) is not different from any typical system to manage variation orders. This similarity is due to most of public clients and consulting firms in Saudi Arabia adopting the basic principles of any variation orders management system. However, there is a considerable differentiation in the detailed process and the method of implementing these systems, due to the weaknesses in understanding the importance of implementing these systems correctly. These weaknesses are caused by the poor interaction and engagement of stakeholders in the change process.

In this section, the research question addresses the current practice of variation order and its weaknesses to investigate their causes and effects and how can they be avoided to improve the current practice.

### **9.2.2 Stakeholder power-interest matrix**

The current practice of variation order management in the Saudi public construction projects does not consider the significance of effective stakeholder engagement in the process of the variation order management. Additionally, the existing body of literature does not identify the responsibilities of the public client or/and design consultant in managing design changes. Several factors were determined as the causes of the ineffective engagement among the design consultants and the public clients. (Refer to section 5.10). From these causes, the significance of engaging the stakeholders has arisen to obtain the best practice. Therefore, the stakeholder power-interest matrix was the best choice to identify the level of power held by each stakeholder. Moreover, it was important to identify his/her level of interest during the process of the variation order management. Here, locating the stakeholders in the power-interest matrix would greatly assist in managing variation orders effectively. This matrix would identify their locations, communication, responsibilities and authority in the developed variation

order management model, to smoothly manage variation orders. Also, the reason for choosing the stakeholder power-interest matrix particularly to be integrated with the current practice of variation order management was because this matrix is the most common technique of mapping stakeholder impact (Johnson and Scholes, 1999). In addition, this matrix is applied when researchers attempt to analyse the influence of stakeholders in a project, as it indicates the type of communication and relationships that the project manager can establish among the stakeholders to manage them effectively.

This section of the research attempted to answer the second part of the research question of how the process of variation orders can be speeded up, the communication and relationship among stakeholders be improved and disputes and conflicts be avoided. This was addressed by identifying the optimum level of engagement in the design stage to determine the stakeholders' responsibilities, positions, tasks and the method of engagement and communication to improve the practice of variation order management.

### **9.3 Meeting the research aim and objectives**

As explained in the above section the research aim was met by developing a model that integrates the basic principles of any system of variation order management and the stakeholder power-interest matrix. The technique of the integration was through determining the optimum level of power and interest for the stakeholders during each stage of variation order management process, to identify the responsibilities of the stakeholders for effective management. This was achieved by different methods carried out for the purpose of the research, starting from a comprehensive literature review, then investigating the current practice, followed by designing the best practice and model development and finally model validation. The developed model has the potential to help the public client and design consultant to become engaged effectively and to overcome the potential obstacles associated with the current practice, in terms of the stakeholder engagement practices. In addition, it helps them to obtain the best practice of variation order management. The aim was achieved through meeting the six supporting objectives described below:

### **9.3.1 Objective one “To investigate and evaluate the current practice of variation order management in the Saudi public construction projects in the design stage and the existing models of variation order management”**

The lack of knowledge about management of variation orders in the Saudi construction industry and the limited published works in relation to variation orders in the context of this study, as acknowledged by several local researchers (e.g. Falgi, 2004; Alsager, 2001; Al-Dubaisi, 2000; Assaf and Elhijji, 2005) and confirmed in Chapters 2 and 3, motivated the researcher to carry out a series of exploratory interviews. The aim of the exploratory research was to better understand the current practice of variation order management at the design stage of public sector construction projects in Saudi Arabia. To do so, a preliminary data collection method was performed, this was by designing semi-structured interviews. To achieve the aim of the interviews, exploratory research questions were formulated from the literature review on variation order management and the Saudi construction industry. An interview guide was designed (see Appendix B) in order to develop the interview questions. The respondents of the exploratory interviews were 23 in total, 7 respondents from different public sectors and 16 from different consulting firms in Saudi Arabia. The collected data from the semi-structured interviews were analysed manually but systematically.

The analysis of the exploratory interviews revealed that the tasks of the parties involved in construction projects at the design stage in Saudi Arabia are not yet clearly identified and understood with regard to variation order management. This issue could be attributed to the fact that there are currently no formalised approaches to managing variation orders during the design process. However, most parties follow the basic principles for any variation order management system, from their experience. The model of the likely common practice currently used in managing variation orders in the design phase can be divided into five main stages, which are: (1) *identifying the variation order*; (2) *analysing and evaluating the variation order*; (3) *estimation and approval*; (4) *implementation* and (5) *documentation*. (Refer to Figure 5.4)

The most significant key findings from the qualitative stage were that the participants of the study strongly emphasised the lack of stakeholder engagement and interaction during the variation order management process, which leads to poor management. Furthermore, it was revealed that stakeholders' responsibilities are not clear enough with regards to change process. These issues were taken into account in the subsequent

development of the study, to engage stakeholders effectively and educate them about the importance of stakeholder engagement in the design phase, to manage variation orders efficiently. Moreover, the existing models in the construction industry revealed little or no attention paid to the significance of linking stakeholder engagement and the variation order management systems. Moreover, in construction research no attempt has been made to identify the stakeholders' key characteristics during the variation order management process. This lack of acknowledgement has led to shortcomings in managing variation orders. s This issue was confirmed from the exploratory interviews.

### ***9.3.2 Objective two “to determine the strengths and weaknesses in the existing condition of variation order management”***

This objective aimed to identify the strengths and weaknesses in the current practice. This objective was achieved by deeply analysing the existing condition and understanding its advantages and disadvantages. The investigation of the current practice showed lack of knowledge and awareness of change management practices in the Saudi public construction industry with emphasis in the design stage. Furthermore, the role of stakeholder engagement and interaction during the change management process, in order to successfully implement any variation order management system is not clearly understood by public clients and design consultants.

The significant finding revealed from this stage is that, the current practice adopts the basic principle of any variation order management system, however with some deficiencies. That means that, to guarantee the successful development and implementation of the proposed model, some amendments are needed to suit the Saudi conditions. Therefore, the strengths and weaknesses must be taken into consideration before developing a variation order management model. This part of the study enabled the researcher to better understand the needs of the proposed variation order management system for it to be applicable for the Saudi public construction industry. The strengths and weaknesses in the current Saudi practice based on the analysis of the exploratory interviews can be summarised as follows:



***Strengths:***

- Project parties apply the most common practices in variation order management.
- Project parties agreed on the need for an effective variation order management system.
- Any improvements to the current practice can be implemented, as the project parties applying the basic principles of variation order management process.

***Weaknesses:***

- Poor co-ordination and communication among the design team
- Not enough attention to variation order management practices
- Poor practices of stakeholder engagement
- Lack of interaction between the client and design consultant during the change
- Stakeholders' responsibilities are not well identified in the change process.

***9.3.3 Objective three “to provide a suggestion of an appropriate technique of engaging the public client and design consultant in the process of variation order management in the Saudi context”***

This objective was achieved by conducting a quantitative study. The data in this stage was collected through a questionnaire survey. The questionnaire aimed to provide an understanding of the appropriate level of power and interest of the stakeholders in order to develop a best practice model. The model development was designed by integrating a stakeholder power-interest matrix into the current process of variation order management. The number of respondents from public clients and design consultants was 217. The data gathered was analysed statistically using SPSS software.

After analysing the data, the stakeholders were located in the power-interest matrix for each stage of the current practice. Then, the developed model and the technique of integrating this matrix into the entire process of variation order management were described. This engagement of stakeholders through the developed model was intended to obtain the best practice of variation order management. Furthermore, this engagement was intended to obtain the most effective practice of engagement among the public clients and design consultants in Saudi public construction projects.

**9.3.4 Objective four “to determine the responsibilities and positions of the stakeholders to speed up the process of variation order management, to improve communication and relationships and avoid the potential problems”**

The developed model for best practice of variation order management intended to determine the responsibilities of the stakeholders during implementation of the developed model to maintain a high performance workflow and to avoid unnecessary interactions. This objective aimed to locate the stakeholders throughout each of the stages of the developed model to enable them to understand their tasks and roles. Moreover, it aimed to speed up the process of variation order management and overcome disputes and conflicts between the stakeholders.

This objective was achieved by locating the stakeholders in the power-interest matrix in each single stage in the best practice model. Locating the stakeholder was based on the analysis of the questionnaire survey. Identification of the stakeholders’ responsibilities assists the design team to better manage the variation orders and to provide a better picture of communication and relationships among stakeholders. This thesis presented one standard way of managing a typical variation order through the developed model application, as an example. The example presented aimed to illustrate the stakeholders’ responsibilities clearly and to show how the model works out in the design stage to manage variation orders.

**9.3.5 Objective five “to design a roadmap implementation strategy to facilitate the model to work out in the Saudi public construction industry”**

This objective sought to provide a basis for a viable best practice of variation order management system and guidance for its implementation. In the light of the findings from the qualitative and quantitative surveys, this objective was met. The designed roadmap helps the public clients and design consultants to understand the task at hand, better allocate available resources and prepare for effective variation order management. The convergence of the results from the existing literature review, the exploratory interviews and the questionnaire highlighted a number of key elements. These elements will facilitate the entire model to work out efficiently.

It is assumed that setting priorities will assist the stakeholders to achieve the objectives of the integrated system of variation order management. In the developed roadmap implementation strategy there are three priorities to guarantee the highest efficiency for

successful development and implementation of the proposed model. These priorities of the roadmap begin by determining the challenges to change and apply the best practice, then enabling the workflow of the model to work out smoothly, by proposing a professional strategy and finally, pointing out the guideline key elements to enable the stakeholders to understand the process of the best practice. Moreover, another category was established to determine the reflection of the identified elements of the roadmap in the existing practice. This perspective intends to support the uniqueness of the roadmap and to understand which elements in the roadmap need more focus than others to assist the stakeholders to move to best practice effectively. Additionally, this category aims to identify the most common obstacles that may face the application of the developed best practice model.

#### **9.3.6 Objective six “to evaluate and validate the developed model in terms of applicability, effectiveness and clarity.”**

This objective intended to evaluate the developed model for the purpose of applicability, effectiveness and clarity. This objective was achieved by testing the effectiveness, clarity and applicability of the developed model. To do so, thirteen experts from public clients and design consultants participated in two focus group sessions. The overall feedback was mainly positive and the comments were considered in the model improvement. All participants expressed their opinions that it was feasible to practice this model in the field and expected that there will be tangible benefits from it. The analysis of the feedback found that the model would be applicable, effective and relatively clear to be applied in the Saudi public construction industry. However, two minor changes to the stakeholders’ positions in the model were made, based on the participants’ suggestions.

### **9.4 Contribution to Knowledge**

The main contribution of the research is the development of a variation order management model to better manage variation orders in the Saudi construction industry. This proposed system for better management was achieved by identifying the optimum level of power and interest for stakeholders to engage them effectively in the process of managing the variation order, to save the variation order management time, improve the communication and relationships among stakeholders and avoid disputes and conflicts. The developed model emphasizes the linkage of the basic principles of variation order management and a stakeholder-mapping approach to engage the involved parties in

managing variation orders effectively. The research provided an extensive review of the Saudi construction industry in terms of the design stage practices, causes of variation orders, their impact and management and stakeholder engagement practices. It has therefore identified the existing gap in knowledge with regard to the strengths and weaknesses in the current practice.

The research confirmed a clear absence of stakeholder engagement during the process of variation order management that led to shortcomings in the current practice. However, in the existing body of literature on the construction industry little or no attention has been paid to the integration of stakeholder engagement and the variation order management systems. This research has contributed also to finding an approach to determine the position and role of the stakeholders involved in variation order management, to identify a best practice. The approach was achieved by an explicit identification of the level of power and interest for the public client and design consultant in each single stage in the developed model to identify where to effectively engage the stakeholder to improve the practice of variation order management.

Furthermore, this research has designed a unique roadmap for an implementation strategy that links the developed model for best practice of variation order management with the actual practice in the Saudi construction industry, based on the findings of the research stages. The key findings were translated to different elements that support the effective implementation of the best practice model. The roadmap implementation strategy was categorised based firstly on the priority of the key elements in the roadmap, and secondly the reflection of the identified elements in the existing practice. This was done to help the stakeholders to move from the current practice to best practice, and thus to guarantee the highest efficiency for successful development and implementation of the proposed model. In addition, the roadmap helps the design consultants and public clients to understand the mechanism of the developed model and avoid any potential obstacles due to the lack of sufficient information in the existing conditions. The uniqueness comes from the elements of the roadmap that link the best practice of variation order management with its requirements for successful implementation.

## 9.5 Benefits of the research

The empirical findings in this research provide a new understanding of variation order management in the Saudi public construction industry. They provide a clear picture of the issues of managing variation orders in the design stage, by linking the basic principles of variation order management to stakeholder mapping. The findings of the study are interpreted in the model as the basis of the final outcome of the research project. The empirical benefits of the model are as follows:

- Improving the quality of variation order management practices during the design stage process by encouraging the stakeholders to well document the initiated variation orders to learn lessons and build up their knowledge.
- Clarifying the stakeholders' responsibilities and positions during the variation order management process by locating them in the power-interest matrix.
- Although the developed model relates to variation order management, attention is paid to culturally related issues, resistance to change, standard public contracts, professional guidelines and knowledge-based supervision.
- The integration of approaches to variation order management and stakeholder engagement provides a sustainable level of effectiveness, workability and strength, minimising the chances of poor implementation and management.
- Despite the value that the model contributes to design practices, it does not add an additional heavy workload during the process of the design and/or variation order management. Instead of developing a completely new approach; the model improves the current practice by integrating the power-interest matrix in each stage, which has been found to be the most appropriate technique for best practice.
- Maintaining a high performance workflow to avoid unnecessary interactions by the involved stakeholders to save the time and cost of the variation order management and to avoid potential conflicts and disputes.
- Helping to minimise potential variation orders in the future construction projects due to the lessons learned.

## 9.6 Limitations of the research

This research has some limitations in terms of its conduct and scope as briefly addressed below:

- The Saudi construction industry is considered the same as any other construction industries in the world. However, each construction industry has its own characteristics. The Saudi construction industry suffers from poor performance and faces some difficult challenges, for instance the tasks of parties involved in construction projects in Saudi Arabia are not yet clearly identified, and also the practice of change management is not yet well established in this relatively young industry. This study focussed on the local problems of variation order management in the Saudi construction industry in the design stage, thus one of the research limitations is that the results may not be easily generalized to construction projects internationally. In addition, this study may not be easily adapted to all stages of construction projects, as it is specific for the design stage.
- In the exploratory interviews stage, because of time constraints, the researcher could only conduct 23 interviews to investigate the current practice of variation order management in the Saudi construction industry. This can be attributed to the fact that, there was a difficulty in reaching private consulting firms who work with the public sector, due to the shortage of information about them, such as names, addresses, and contact details.
- In the quantitative survey a disparity in quantity of responses among the stakeholders was noticed. This disparity in quantity of responses between public sector and consulting firms relates to the bureaucracy and lack of knowledge about the importance of research in public sectors. Moreover, the difficulty in following up some public sector participants, due to lack of communication were another cause of the disparity in quantity of the responses.
- The developed model for best practice was not tested through model application in a real life project to assess how it will perform in a real project, due to the limited resources, time constraints and difficulty in getting approval from the stakeholders to test the model.
- Lack of contractor involvement in the process of the developed model, due to the limited scope of the research.

- Narrow applicability of the research outcomes in related research areas, as this research deals only with a certain stage, stakeholder and country.
- Complexity in arranging a suitable time for the experts to conduct the focus group sessions. The first session was cancelled twice, due to some participants sending excuses for non-attendance.

## **9.7 Recommendations for future research**

During the progress of the study, several areas were identified as useful subjects of study. The recommendations made in this section were related to the research issue being investigated. This research has prompted many subjects that suggest further investigations. It is recommended that further research be carried out in the following areas:

- Making some refinements to the developed model by changing the adapted stakeholder mapping method in this research, which is the power/interest matrix, and expanding to the three-dimensional stakeholder mapping of interest, power and attitude. The three-dimensional stakeholder mapping will cover more different aspects with regards to the stakeholder behaviour during the process of variation order and will measure to what extent the involved stakeholder will support or resist the process of managing variation orders from stage to stage.
- This research was performed within the context of the Saudi public construction projects, and further research is required to investigate the applicability and effectiveness of adopting the developed model in other different worldwide construction industries either in public or private sectors. The importance of this study is to generalize the developed model to be applicable and effective internationally.
- Considering the benefits of a BIM environment to efficiently implement variation orders and encourage the stakeholders to effectively collaborate during the process of the design stage.
- Developing a similar model that is applicable for the entire lifecycle of a construction project. This could be done by expanding the involved stakeholders and adding the contractor to the study. This would cover more parties in the study and provide a larger picture of variation order management. Additionally, implementing the model in the other

procurement routes, could be carried out to make the model applicable to different procurement routes. Also, the developed model could be taken into consideration to see if it was appropriate to other types of construction projects.



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## **APPENDICES**



## **Appendix A**

### **Cover letter for the interview and interview questions**

Dear Sir/Madam,

I am a research student in the School of the Built Environment at Herriot-Watt University in the UK, conducting research under the supervision of Dr. Graeme Bowles and Dr. Zhen Chen. I am researching better management of variation orders in the Saudi public construction projects at the design stage.

The lack of knowledge about management of variation orders in Saudi Arabia and the limited published work in relation to variation orders in the Saudi construction industry, have led the researcher to carry out a series of exploratory interviews. The aim of the exploratory research is to better understand current practice of variation orders management at the design stage of public sector construction projects in Saudi Arabia.

Please, I respectfully ask you to answer the interview questions through recorded phone calls to speed up the process of the research, as the research is carried out in the UK and the research case is in Saudi Arabia. Please e-mail me back at your suitable time to make the call. Be assured that the data collected will be kept confidential and no firm, organisation or individual will be identified in the thesis or in any report or publication based on this research. A copy of the summary report will be made available if required.

I would also like to assure you that this study has been reviewed and received ethics clearances through the office of research ethics at Heriot-Watt University.

Thanks in advance for your co-operation.

Yours sincerely  
Jawad Al Suliman  
E-mail: [ja169@hw.ac.uk](mailto:ja169@hw.ac.uk)

(A) Personal background:

1. Name (optional):
2. Work organisation: ( ) Public client ( ) Private consulting firm
3. Position:
4. Years of experience: ( ) 0-5 years ( ) 6-10 years ( ) 11-15 years ( ) 16-20 years ( ) more than 20 years

(B) Management of variation orders in the design stage:

5. How do variation orders negatively affect the design stage?

6. How do you manage variation orders in the design stage?

7. What are the problems associated with managing variation orders?

(C) Existing models/frameworks to manage variation orders:

8. Do you use a model/framework to manage variation orders in the design stage? (If yes, go to Q10)

9. What are the reasons behind not using a model/framework to manage variation orders? (Go to Q13)

10. What is the model/framework do you use?

11. Have you faced any problems with this model/framework? (If no, go to Q13)

12. What are these problems?

13. From your experience is it necessary to have a model/framework to manage variation orders?

14. If yes or no, what are the reasons?

## Appendix B

### Interview topics and guide for the qualitative study analysis

Interview topic	Questions	Objectives of the questions	Response analysis
Personal background for the public clients and consulting firms	1- Name (optional): 2- Work organisation: ( ) Public client ( ) Private consulting firm 3- Position: 4- Years of experience: ( ) 0-5 years ( ) 6-10 years ( ) 11-15 years ( ) 16-20 years ( ) more than 20 years	To recognize the respondent background, organization, and years of experience to take these details into consideration in the qualitative analysis	The analysis will be based on the respondent organization as the study deals with public clients and consulting firms to differentiate the analysis between them
Current practice of variation orders management in the Saudi public construction projects at the design stage	5. How do variation orders negatively affect the progress of the design stage regardless if the variation order is beneficial or detrimental?  6. How do you manage variation orders in the design stage?  7. What are the problems associated with managing variation orders?	To better understand the current practice of variation orders management in Saudi Arabia and to evaluate the criteria of variation orders management. To examine the problems with managing variation orders currently.	In this section the responses will be qualitatively analyzed by comparing the current practice of variation orders management that given by interviewees to identify the most common technique that is used to manage variation orders
Existing models/ Frameworks to manage variation orders in the Saudi construction projects	8. Do you use a model/framework to manage variation orders in the design stage? (If yes, go to Q10)  9. What are the reasons behind not using a model/framework to manage variation orders? (Go to Q13)	To identify the existing model/ frameworks to manage variation orders and to determine the problems with applying these techniques. Also to investigate the importance of adopting and developing a model/	In this section the responses will be qualitatively analyzed. Each response will be carefully analyzed and evaluated to see the interviewees' experience and opinions on developing and adopting a certain criteria to manage

	<p>10. What is the model/framework do you use?</p> <p>11. Have you faced any problems with this model/framework? (If no, go to Q13)</p> <p>12. What are these problems?</p> <p>13. From your experience is it necessary to have a model/framework to manage variation orders?</p> <p>14. If yes or no, what are the reasons?</p>	<p>framework. To allow interviewees to come up with new themes to support the development of the management of variation orders. To understand the challenges of applying a variation order management system.</p>	<p>variation orders</p>
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## **Appendix C**

### **Qualitative analysis (thematic matrix)**

Impact of variation orders	Significant negative impact- 1,8,11,14,15,18, 20, 23	Detrimental variations have greater impact- 1,8,14,18	Beneficial variations need to be managed- 1,14	Delay in the design stage- 2,5,9,10,18	Cost overruns- 2,9,18	Design errors- 8,14	Disputes and conflicts- 4,17,21	Quality defects- 6,14,21	Design productivity- 14	Effective design- 9,18	Design Performance and progress- 13,18		
How do manage variation orders	No formalised approach- 1,4,9,14,22	Simple process- 1, 14	Reviewing the design 8,16,18	Providing information about variation orders- 7,19	Negotiation- 4,8,21	Estimating the cost and time of the variation orders- 3,14,19	No problems with variation orders management- 5	Variation orders are normal to occur- 1,5	Variation orders are easy to manage- 4,5	Having good relation with the consultant- 2,5	Well identification of the change 14,18	Good evaluation of the change- 14	Getting the approval and implementing the change orders- 18
	Documenting and recording the change- 11,14,18	Reporting to the client for need of variation order 20,23	Having good project management practices- 16,17,21	Looking how variation orders are done from previous projects- 13,18	Time of applying any change is different depends on the variation- 1,13	No need for client approval for some minor changes- 9,13,18,21,22							
Problems associated with the current variation orders management	Poor change management- 2,8,11	Lack of trust- 9,10,12,20,23	Lack of awareness- 8,14	Lack of knowledge about variation orders management- 8	Bad reputation to the project parties- 2,9,14,21	Poor co-ordination and communication- 1,10,20	Lack on written down contracts- 14,18	Change in one discipline affects others- 14,19,21	Lack of training courses and workshops- 22	Poor definition of change management- 18	Late design changes- 8,14,21	Insufficient change details- 10,19,20	Lack of professional engineers- 2,5,12,13,19
	Not providing the need for the variation orders- 11,19,23	Lack of experience with change management- 14,18	Poor relation between client and consultant- 1,16	Initiating variation orders after the finalised design- 4,17	Lack of competitive process- 9	Bureaucracy of public sectors- 18	No attention to negative impact of variation orders- 7,17	Variation orders affect our other projects- 14	Absence of change management system practices- 1,19	Clients should provide more details about the variation orders- 9,11,21	No enough attention to the design stage- 4,5,9,22	Consultants making design changes without consulting the client- 1,3,	Need for strong structure for variation orders management- 1
Using models/ frameworks to manage variation orders	Currently no existing model or framework to manage variations- 1,2,3,7,9,11,14	Just with joint-venture with international consultants- 14	Having no ideas about models or frameworks to manage variation orders- 1,2,4,7,9,10,13,17,20,22,23										Lack of stakeholder engagement appropriately 2,6,8,10,14,16,19 ,20,22
Causes of not using models/ frameworks	Lack of awareness about the importance 14,18,20	Lack of knowledge 1,9,14,17	Lack of experiences with change management- 18,21	Lack of sufficient contracts 8,10,14,15	No effective communications- 2,10,16,18	Assuming that it is complex- 1,13	Scope of the project is not clear enough- 19,22	Causes of variation orders are not identified- 8,11	Initiating high amount of variations orders by the client 8,13,18	Requesting the variations to be implemented immediately- 12,19	Clients are not educated about using models and frameworks- 14	No enough meetings with the clients- 11,19,21	Choosing consultants without competitive process- 8,11
	No enough details are produced during the design stage- 9	Not getting information from the client quickly- 14,18,21	Cultural related issues 1,4,9,10,18,19										
The existing model/ framework to manage variation orders	Straightforward process to manage variation orders- 11,14,18,20	Identifying the variation order- 9,17,18,19	Cost and time estimations- 2,7,18,14	Approval of the variation orders- 8,9,13,14,18	Implementation of the variation order- 2,14,18	Documentation of the variation order- 14,18							
Problems with using model/ framework to manage variation orders	Assuming it is hard to be applied- 1,5,9,17	Lack of awareness of change management systems 1,18,23	Assuming it is costly- 2,7,17	Need for training courses and workshops- 4,5,18	Need for professional and qualified engineers- 1,5,18								
The need for variation orders management system	Significant need- 1,3,5,14,18,20, 23	Would assist us to better manage variation orders- 11,14	Would help to identify the variation order- 3,5,13	Analysing the variation order comprehensively - 1,12,18	Leading to have effective design and review process- 9,14	Better understanding for variation orders- 18	Avoiding unforeseen design errors- 19,22	Need for strong structure for variation orders management- 1	Training courses, variation process and contract' terms must be reviewed before applying a change management system- 11,18,21				

## Appendix D

### Survey Cover Letter and Questionnaire

Dear Sir/Madam,

I am a research student in the School of the Built Environment at Herriot-Watt University in the UK, conducting research under the supervision of Dr. Graeme Bowles and Dr. Zhen Chen. I am researching better management of variation orders in the Saudi public construction projects at the design stage.

A previous study in this research revealed that, the current practice of variation order management in the Saudi public construction projects follows the basic principles of any variation order management system, which can be described as *identifying, evaluating the variation order, estimation, approval, implementation and documentation*. However, the Saudi public construction industry shows some deficiencies in variation order management at the design stage due to the poor stakeholder engagement. Hence, this survey aims to integrate stakeholder power-interest matrix with the current process of variation order management to investigate the level of power and interest of the involved stakeholders (public clients and design consultants) in order to improve the variation order management process during the design stage.

Please, I respectfully ask you to complete the questionnaire and be assured that the data collected will be kept confidential and no firm, organisation or individual will be identified in the thesis or in any report or publication based on this research. A copy of the summary report will be made available if required.

I would also like to assure you that this study has been reviewed and received ethics clearances through the office of research ethics at Heriot-Watt University

Thanks in advance for your co-operation.

Yours sincerely  
Jawad Al Suliman  
E-mail: [ja169@hw.ac.uk](mailto:ja169@hw.ac.uk)



### Section (A): Personal background:

1. Name (Optional):
2. What is your work organisation?
  - ☐ Public sector
  - ☐ Private consulting firm (designer)
  - ☐ Other
3. What is your job in the design process of your organisation?
  - ☐ Project manager
  - ☐ Design manager
  - ☐ Architect
  - ☐ Civil engineer
  - ☐ Site engineer
  - ☐ Quantity surveyor
  - ☐ Other: specify .....
4. Have you been involved in designing public construction projects?
  - ☐ Yes
  - ☐ No
5. Please specify your years of experience:
  - ☐ 0-5
  - ☐ 6-10
  - ☐ 11-15
  - ☐ 16-20
  - ☐ More than 20

### Section (B-1): the significance of stakeholder engagement in the variation order management

- Please indicate your response throughout the questionnaire by ticking the appropriate box where (1= not at all and 7= to a great extent)

6. To what extent do you agree with the following statements to better manage variation orders at the design stage?

Statement	1	2	3	4	5	6	7
a) Having a good relationship between the public client and the consulting firm to manage variation orders.							
b) Establishing an effective communication between the public client and the consulting firm to manage variation orders.							

c) Poor co-ordination between public client and consulting firm negatively affects the performance of variation order management.							
d) Understanding of stakeholder engagement helps for better management of variation order process.							
e) Identification of the stakeholders' responsibilities assists the design team to better manage the variation order							
f) Poor implementation of stakeholder management can negatively affect the performance of variation order management							
g) Engaging the stakeholders in the change process							
h) All stakeholders should know their own tasks and roles in the change process							
i) The stakeholder commitment is important to manage variation orders							

## **Section (B-2): the significance of stakeholder engagement in the process of variation order management**

Please indicate your response throughout the questionnaire by ticking the appropriate box where (1= not at all and 7= to a great extent)

7. To what extent do you agree with the following statements during the process of variation order management at the design stage?

Statement	1	2	3	4	5	6	7
a) Interaction among stakeholders assists the design team to better manage the variation order.							
b) Stakeholder engagement depends on the size and cost of the variation order							
c) The client and designer should meet to manage every design change.							
d) Personalities and ethics of clients and consultants influence decision making in the design changing process.							
e) Cultural diversity between public client and consulting firm negatively influences the performance of variation order management							

### Section (C): Integration of stakeholder power-interest matrix with the current variation order management

8. In your opinion, what should the level of *power* and *interest* for public client and consulting firm in each principle of the variation order management process during the design stage? (Please: tick low or high for each principle and stakeholder)

**Power:** means the power the client and consultant hold

**Interest:** means interest in supporting change process

**High:** means the level of power and interest is high

**Low:** means the level of power and interest is low

Principle	Public client				Consulting firm			
	Power		Interest		Power		Interest	
	Low	High	Low	High	Low	High	Low	High
1- Identify variation								
2- Evaluate variation								
3- Estimate cost and time								
4- Approval								
5- Implementation								
6- Documentation								

- Please indicate your response throughout the questionnaire by ticking the appropriate box where (1= not at all and 7= to a great extent)

9. To what extent do you agree that the integration of the level of power and interest with the current practice of variation order management will assist to better manage variation orders?

1	2	3	4	5	6	7

## Section (D): Effectiveness of integrating stakeholder power-interest matrix with the current variation order management

- Please indicate your response throughout the questionnaire by ticking the appropriate box where (1= not at all and 7= to a great extent)

10. To what extent do you agree with the following statements for the effectiveness of applying a system to manage variation orders at the design stage?

Statement	1	2	3	4	5	6	7
a) Not having a system to manage variation orders would increase the duration to implement the variation order.							
b) Not having a system to manage variation orders would lead to conflicts and disputes among stakeholders.							
c) Involving the stakeholders by identifying the level of power and interest for each one in a variation order management system would assist to have a good communication and speed up the process of implementing the variation order							
d) Identifying the level of power and interest for each stakeholder in a variation order management system would assist to avoid conflicts and disputes in the process of implementing the variation order							
e) Developing a model that integrates the level of power and interest with the basic principles of variation order management would better manage variation orders							

11. Please feel free to add any comments that you think are related to the integration of power and interest level with the current practice of variation order management to better manage variation order at the design stage

## **Appendix E**

### **Focus group invitation letter**

Dear Sir/Madam,

I am a research student in the School of the Built Environment at Herriot-Watt University in the UK, conducting research under the supervision of Dr. Graeme Bowles and Dr. Zhen Chen. I am researching better management of variation orders in the Saudi public construction projects at the design stage.

The researcher developed a model to improve the practice of variation order management in the Saudi public construction projects through integrating the basic principles of variation order management with the power/interest matrix. The aim of the validation exercise is to test the model's effectiveness, clarity and applicability.

Please, I respectfully ask you to accept the invitation and participate in the focus group session to contribute the development of the research. The focus group sessions will be held at Le Meridian Jeddah Hotel. Participants can choose one of these times:

1- 07<sup>th</sup> Jan 2014 at 7pm for 2 hours.

2- 08<sup>th</sup> Jan 2014 at 7pm for 2 hours

Please e-mail me back at your suitable time to confirm the number of participants. Be assured that the data collected will be kept confidential and no firm, organisation or individual will be identified in the thesis or in any report or publication based on this research. A copy of the summary report will be made available if required. Also, I ask your permission to take some photos to include it in the research appendices.

I would also like to assure you that this study has been reviewed and received ethics clearances through the office of research ethics at Heriot-Watt University.

**Note:** Coffee break will be provided.

Thanks in advance for your co-operation.

Yours sincerely  
Jawad Al Suliman  
E-mail: [ja169@hw.ac.uk](mailto:ja169@hw.ac.uk)

## Appendix F

### Focus group questionnaire

#### Section (A): Personal background:

1. Name (Optional):

2. What is your work organisation?

Public sector ( ) Private consulting firm (designer) ( )

3. What is your job in the design process of your organisation?

Project manager ( ) Design manager ( )

Architect ( ) Civil engineer ( )

Site engineer ( ) Quantity surveyor ( )

Other: specify .....

4. Please specify your years of experience:

0-5 ( ) 6-10 ( )

11-15 ( ) 16-20 ( )

More than 20 ( )

#### Section (B): Model applicability, clarity and effectiveness:

5. Please indicate your rate of applicability of the model for the following criteria.

Where 1= inapplicable and 7= applicable.

Statement	1	2	3	4	5	6	7
a) The model process.							
b) Architecture of the model.							
c) The model design.							
d) The model achievability.							
e) Integrating power and interest levels with variation order management.							
f) The actions required to move to best practice							

6. Please indicate your rate of clarity of the model for the following criteria. Where 1= unclear and 7= clear.

Statement	1	2	3	4	5	6	7
a) Stakeholders' responsibilities.							
b) Determining the level of power and interest.							
c) Communication method.							
d) Stakeholders' positions.							
e) Model requirements.							

7. Please indicate your rate of effectiveness of the model for the following criteria. Where 1= ineffective and 7= effective.

Statement	1	2	3	4	5	6	7
a) Reducing unnecessary interactions.							
b) Method of relationship.							
c) Avoiding conflicts and disputes.							
d) Speeding up the process.							
e) Out comes of the model.							

8. Please indicate your rate of applicability, clarity and effectiveness of the entire model. Where 1= inapplicable, unclear and ineffective and 7= applicable, clear and effective.

Statement	1	2	3	4	5	6	7
a) Applicability.							
b) Clarity.							
c) Effectiveness.							



### Section (C): Open questions:

9. What success can you get from the model application?
10. What are the potential barriers in the model application?
11. In your opinion, how can the model be improved?

## Appendix G

### The hotel quotation for the conference room reservation

Date: 31/12/2013

#### QUOTATION

EVENT:	Ali M. AlSulaiman EST. Mr. Jawad Ali Suliman - MOB: 050 5557575
DATE:	07 <sup>th</sup> & 08 <sup>th</sup> Jan. 2014 (Tuesday & Wednesday)
TIME:	19:00 -23:00
NUMBER OF ATTENDEES :	06 Pax (Guaranteed) Males
LADIES :	
GENTS :	Ladies attendance needs IMARAH PERMIT
MENUS COFFEE BREAK A.V EQUIPMENT SPECIAL ARRANGEMENT	- Coffee break
PRICE(S)	SR. 2000 for room rental per day SR. 100 Net Per person per day inclusive coffee break only
VENUE	TBA
SET UP	U-shape
EQUIPMENT	LCD Projector, screen, flip chart board, marker pens, pads and pencils,
INTERNET YES <input type="checkbox"/> NO <input type="checkbox"/>	Wireless high speed internet is available in our meeting rooms upon request and subject to applicable charges
REMARKS	

Le MERIDIEN

#### TERMS & CONDITIONS:

##### 1. EVENT AUTHORIZATION:

In pursuant to circular No. 653590 of the Jeddah Governor's office dated May 25<sup>th</sup> 2008, the Hotel Management requires that the following documents be furnished 72 hours prior to any business meetings organized **by a Saudi Arabia registered company or establishment:**

- Official request on company Original letterhead (**no copies**)
- Agenda of Meeting
- Letter must be signed by company authorized person, (if not the Owner, then the Company GM Or Administrative Mgr) Company stamp, copy of his ID or IQAMA
- Date & time of the event
- Total Number of attendees
- Speaker details (if any)

مريديان جدة

LE MERIDIEN

JEDDAH

ص.ب 11633 طريق المدينة جدة 21463 المملكة العربية السعودية  
P.O. Box 11633 Madinah Road Jeddah 21463 Saudi Arabia  
T +966 2 663 3333  
F +966 2 663 2333  
lemeridien.com/jeddah  
lemeridien-jeddah.com

جواد السليمان  
14/1/2014

N 21° 35' E 39° 10'

## Appendix H

### Some pictures from the focus group sessions

#### Session 1:



## Session 2:





# Appendix I

## Focus group presentation

# Butter management for variation orders in the Saudi public construction industry in the design stage

By  
Jawad Alsuliman

## Introduction

- Hardly possible to deliver a construction project without VO (Ssegawa et al., 2002).
- Even in well-planned projects, change might be necessary (Arain and Pheng, 2007)
- Change is “fact of life” for construction projects (Revay, 2002).

## Research problem

- Variation orders affect the progress of construction projects
- Variation orders in the design stage always lead to poor performance (Oladapo, 2007).
- The design stage is with high likelihood of variations occurrence (Motawa, 2007).

## Research limitation

- This study deals with variation orders in the Saudi construction industry in the design phase.
- This study is limited to public building construction projects
- This study deals with public sectors in Saudi Arabia that adopt traditional procurement route
- This study focuses on governmental organisations as clients and consultancy firms as consultants

## This workshop aims:

- To test the model's effectiveness, clarity and applicability.
- To discuss and validate what success the experts think to have.
- To discuss the barriers of the model implementation.
- To discuss how could the model be improved.

## Variation orders in the Saudi construction industry

- Variation orders are the major cause of failure in construction project performance.
- Cost overruns due to variation orders equal 6% to 10% of the original contract value.
- Design errors are considered as the most important cause of variation orders.
- Clients are dissatisfied because of the high percentage of variation orders due to design errors.

## Research aim

- “To better manage variation orders in the Saudi public construction projects in the design stage”

This aim will be achieved by engaging clients and consultants effectively during the process of VOM throughout different methods.

## Exploratory interviews

- Exploratory interviews were carried out to investigate the current practice of variation orders in the Saudi construction industry.
- Research sample was 23 participants from public sectors and consulting firms.

## Main finding

- No formalized approach to manage VO.
- Saudi construction industry adopts the basic principles of any VOM system (*identification, evaluation, estimation, approval, implementation and documentation*).
- Poor stakeholder engagement
- No clear responsibilities for the design parties.

## Research design

```

graph TD
    subgraph Technique
        A[Literature review] --> B[Qualitative Exploratory interviews]
        B --> C[Formulating research propositions]
        C --> D[Qualitative Questionnaire survey]
        D --> E[Establishing a roadmap implementation strategy]
    end
    subgraph Aim
        A1[To present and discuss relevant studies  
- To identify the major approaches of VOM]
        B1[To investigate the current practice of VOM]
        C1[To confirm the purpose of integrating power-interest matrix]
        D1[To identify the level of power and interest]
        E1[To provide a solid basis of best practice]
    end
    subgraph Key findings
        A2[• Lack of studies about the Saudi context  
• No attention to the integration of stakeholders and VOM systems]
        B2[• No formalized approaches  
• Poor stakeholder engagement  
• No clear responsibilities]
        C2[Propositions were verified and confirmed]
        D2[An integrated system of best practice was developed]
    end
    A --> A1
    B --> B1
    C --> C1
    D --> D1
    E --> E1
    A1 --> A2
    B1 --> B2
    C1 --> C2
    D1 --> D2
    E1 --> D2
  
```

## Current conceptual framework

```

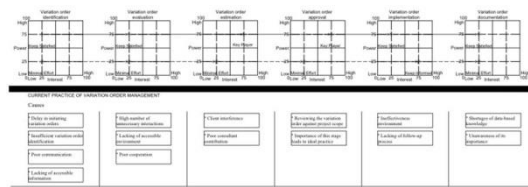
graph TD
    A[Variation proposed] --> B[Designers]
    B --> C[Identify variations  
• Variation type  
• Variation cause  
• Variation estimate]
    C --> D[Evaluate variations  
• Used for reaction  
• Impact of reaction]
    D --> E{Rejection or No}
    E -- No --> F[Estimate cost and duration]
    F -- Not met --> G[Rejection]
    F -- Yes --> H[Approved for main variations in response to not need cost approval]
    H --> I{Approved}
    I -- Yes --> J[Implementation]
    I -- No --> K[Change order]
    J --> L[Documentation]
    L --> M[Lessons and knowledge learnt]
  
```

## Linking the stakeholder engagement and VOM process

- Literature review pays no attention to stakeholder engagement during the process of variation order management.
- Engagement of stakeholders throughout project activities is one of the critical factors of success.
- Stakeholder power-interest matrix was selected as a method to engage the stakeholders to better manage VO.

	Low	High
Power Low	A Minimal effort	B Keep informed
Power High	C Keep satisfied	D Key players

## Level of power and interest in the current practice and causes of poor performance



## Research propositions

• Three research propositions were formulated.

• *An appropriate level of stakeholder engagement in the current practice of variation order management leads to the greater success of the management of variation orders.*

• *Integration of stakeholder power-interest matrix and the basic principles of variation order management system would lead to best practice of VOM.*

• *Applying a system that identifies the level of power and interest for the involved stakeholder would better manage variation orders.*

• The propositions aimed to confirm the significance of integrating the stakeholder mapping and VOM process.

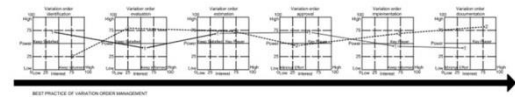
## Questionnaire survey

- To verify and confirm research propositions.
- To identify the level of power and interest for public clients and design consultants during the stages of VOM.
- To integrate the basic principles of VOM and stakeholder mapping to develop a best practice.

• **Survey sample** was 217 respondents (87 clients and 130 consultants).

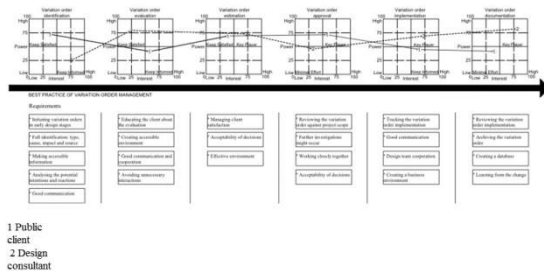
## Main findings of the quantitative method

- Research propositions were verified and confirmed.
- Stakeholders were located and positioned in the power-interest matrix.
- Best practice was developed.
- The responsibilities of stakeholders were determined.



1 Public client 2 Design consultant

## How to make the best practice happen (causes, requirements and actions)



1 Public client  
2 Design consultant

## Implications of the best practice

- It clarifies the stakeholders' responsibilities
- It determines the appropriate level of stakeholder engagement
- It reduces the quantity of the unnecessary interactions by public clients
- It improves the communication and relationship among the stakeholders.
- It assists the stakeholder to avoid conflicts and disputes.
- It assists to speed up the time of variation order implementation.

## Need for roadmap implementation strategy

- Developing best practice alone cannot influence the required changes (Bernstein and Pittman, 2004).
- It is widely recognised that organisations have gaps between what they know and what they do (Pfeffer and Sutton, 2000).
- There is a concern that the integrated system may fail to work out.

So, it was imperative to design a roadmap to successfully implement the best practice.

## Designing the best practice implementation roadmap.

• Three categories were identified:

- *Challenges identified in implementing best practice*
- *Need for an effective implementation strategy*
- *Need for professional guidelines*

Best practice implementation readiness



Any Questions